Economic Considerations of Proposed Whole Effluent Toxicity Control Amendment for California

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Prepared for:

California State Water Resources Control Board
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List of Exhibits

Acronyms and Abbreviations

BMP	Best management practice
CTR	California Toxics Rule
CWA	Clean Water Act
CWC	California Water Code
EPA	Environmental Protection Agency
MEP	Maximum extent practicable
mgd	Million gallons per day
MS4	Municipal separate storm sewer system
NPDES	National Pollutant Discharge Elimination System
NSEC	No significant effect concentration
PCS	Permit compliance system
POTW	Publicly owned treatment works
RTA	Refractory toxicity assessment
SIC	Standard industrial classification
SIP	Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays and Estuaries
SWMP	Storm water management plan
TIE	Toxicity identification evaluation
TMDL	Total maximum daily load
TRE	Toxicity reduction evaluation
TST	Test of significant toxicity
TU	Toxicity unit
WDR	Waste discharge requirement
WET	Whole effluent toxicity
WRP	Water reclamation plant
WWTP	Wastewater treatment plant

1 Introduction

This report updates the 2008 analysis by Science Applications International Corporation (SAIC) on the economic considerations associated with the State Water Resources Control Board's (State Water Board) Amendment to the Water Quality Control Plan for Enclosed Bays and Estuaries of California (Amendment) incorporating statewide numeric whole effluent toxicity (WET) objectives for aquatic life beneficial use protection and minimum requirements for implementation.

1.1 Background

The Clean Water Act (CWA) directs states, with oversight by the U.S. Environmental Protection Agency (EPA), to adopt water quality standards to protect the public health and welfare, enhance the quality of water, and serve the purposes of the CWA. Under Section 303, state water quality standards must include: (1) designated uses for all water bodies within their jurisdictions, (2) water quality criteria sufficient to protect the most sensitive of the uses, and (3) an antidegradation policy consistent with the regulations at 40 CFR 131.12. The CWA also requires states to hold public hearings once every three years for the purpose of reviewing applicable water quality standards and, as appropriate, modifying and adopting standards. The results of this triennial review must be submitted to EPA, and EPA must approve or disapprove any new or revised standards.

In implementing the CWA, the State Water Board and the Regional Water Quality Control Boards (Regional Water Boards; together the Water Boards) follow the integrated approach to water quality-based toxics control recommended by EPA. This approach combines the use of chemical-specific and WET limits to control the discharge of toxics to surface waters. Chemical-specific limits provide control of known pollutants in a discharge; WET limits provide control of unknown pollutants and the aggregate effects of combined pollutants in a discharge. Both chemical-specific and WET limits are crucial to water quality-based control in California.

The California Toxics Rule (CTR) establishes chemical-specific criteria applicable to inland surface waters, enclosed bays, and estuaries. The Amendment for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California (SIP) provides procedures for implementing the criteria in National Pollutant Discharge Elimination System (NPDES) permits. The SIP also addresses toxicity control. As directed by the State Water Board, the Amendment will supersede the toxicity control provisions in the SIP to clarify the appropriate form of WET effluent limits in NPDES permits and standardize implementation in the permitting process. The Amendment also applies to Waste Discharge Requirements (WDR) and the irrigated lands regulatory program, and supersedes existing Basin Plan requirements.

1.2 Scope of the Analysis

The California Water Code (CWC) requires the Regional Water Boards to take "economic considerations," among other factors, into account when they establish water quality objectives.

In doing so, State Water Board (1999; 1994) concluded that, at a minimum, the Water Boards must analyze:

- Whether the proposed objective is currently being attained
- If not, what methods are available to achieve compliance
- The cost of those methods.

If the economic consequences of adoption are potentially significant, the Regional Water Boards must explain why adoption is necessary to ensure reasonable protection of beneficial uses or prevent nuisance. The Regional Water Boards can adopt objectives despite significant economic consequences; there is no requirement for a formal cost-benefit analysis.

Consistent with State Water Board (1999; 1994) guidance, this report provides analysis of whether dischargers are likely to be able to comply with the Amendment, the potential control methods to achieve compliance for dischargers that would be in violation, and the potential cost of such controls. The evaluation is based on currently available data only, and needed controls and costs reflect only incremental expenditures associated with the Amendment (not controls needed to comply with existing regulatory requirements). This analysis does not address potential benefits of the Amendment.

1.3 Organization of Report

The remainder of this report is organized as follows:

- **Section 2: Current Regulatory Framework** – describes the current applicable toxicity criteria and implementation procedures that provide the baseline for the analysis of the incremental impact of the Amendment.
- **Section 3: Proposed Amendment** – describes the toxicity control amendment.
- **Section 4: Method for Evaluating Compliance and Costs** – describes the method for evaluating compliance under the current regulatory framework and the Amendment, and estimating potential incremental Amendment costs.
- **Section 5: Results of the Analysis** – provides the estimates of compliance and costs, and discusses the uncertainties associated with the estimates.
- **Section 6: References** – provides the references used in the analysis.
- **Appendix A**: Facility Analyses**:** provides information on individual sample facilities and the detailed compliance analyses.

2 Current Regulatory Framework

This section identifies the current framework for regulating discharges to inland surface waters, enclosed bays, and estuaries. The current regulatory framework is the baseline against which cost changes associated with the Amendment are determined. Thus, only costs that are greater or less than the costs associated with the baseline (i.e., incremental costs) would be attributable to the Amendment.

2.1 Existing Toxicity Provisions

Exhibit 2-1 shows the toxicity provision in existing Regional Water Board Basin Plans.

Exhibit 2-1. Existing Regional Water Board Toxicity Provisions

Regional Water Board	Basin Plan Toxicity Provisions
North Coast (1)	• All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life. • The survival of aquatic life in surface waters subjected to a waste discharge, or other controllable water quality factors, shall not be less than that for the same water body in areas unaffected by the waste discharge, or when necessary for other control water that is consistent with the requirements for "experimental water" as described in Standard Methods for the Examination of Water and Wastewater. As a minimum, compliance with this objective shall be evaluated with a 96-hour bioassay. • Effluent limits based on acute bioassays of effluents will be prescribed. Where appropriate, additional numerical receiving water objectives for specific toxicants will be established as sufficient data become available, and source control of toxic substances will be encouraged.
San Francisco Bay (2)	• All waters shall be maintained free of toxic substances in concentrations that are lethal to or that produce other detrimental responses in aquatic organisms, including but not limited to, decreased growth rate and reproductive success of resident or indicator species. • There shall be no acute toxicity in ambient waters, defined as a median of less than 90% survival, or less than 70% survival, 10% of the time, of test organisms in a 96-hour static or continuous flow test. • There shall be no chronic toxicity in ambient waters, defined as a detrimental biological effect on growth rate, reproduction, fertilization success, larval development, population abundance, community composition, or any other relevant measure of the health of an organism, population, or community. • The health and life history characteristics of aquatic organisms in waters affected by controllable water quality factors shall not differ significantly from those in areas unaffected by controllable water quality factors.

Exhibit 2-1. Existing Regional Water Board Toxicity Provisions	
Regional Water Board	**Basin Plan Toxicity Provisions**
Central Coast (3)	• All waters shall be maintained free of toxic substances in concentrations which are toxic to, or which produce detrimental physiological responses in, human, plant, animal, or aquatic life. • Survival of aquatic life in surface waters subjected to a waste discharge or other controllable water quality conditions, shall not be less than that for the same water in areas unaffected by the waste discharge or, when necessary, for other control water that is consistent with the requirements for "experimental water" described in Standard Methods for the Examination of Water and Wastewater. As a minimum, compliance with this objective shall be evaluated with a 96-hour bioassay. • Effluent limits based on acute bioassays of effluents will be prescribed; where appropriate, numeric receiving water objectives for specific toxicants will be established as sufficient data become available, and source control of toxic substances is encouraged.
Los Angeles (4)	• All waters shall be maintained free of toxic substances in concentrations which are toxic to, or which produce detrimental physiological responses in, human, plant, animal, or aquatic life. • Survival of aquatic life in surface waters subjected to a waste discharge or other controllable water quality conditions shall not be less than that for the same water in areas unaffected by the discharge or, when necessary, for other control water. • There shall be no acute toxicity in ambient waters, including mixing zones. The acute toxicity objective for discharges dictates that the average survival in undiluted effluent for any 3 consecutive 96-hour static or continuous flow bioassay tests shall be at least 90%, with no single test having less than 70% survival when using an established EPA, State Board, or other protocol authorized by the Regional Water Board. • There shall be no chronic toxicity in ambient waters outside of mixing zones. To determine compliance with this objective, critical life stage tests for at least three test species with approved testing protocols shall be used to screen for the most sensitive species. The test species used for screening shall include a vertebrate, an invertebrate, and an aquatic plant. The most sensitive test species shall then be used for routine monitoring. • Effluent limits for specific toxicants can be established by the Regional Water Board to control toxicity identified under TIEs.
Central Valley (5)	• All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life. This objective applies regardless of whether the toxicity is caused by a single substance or the interactive effect of multiple substances. • The survival of aquatic life in surface waters subjected to a waste discharge or other controllable water quality factors shall not be less than that for the same water in areas unaffected by the waste discharge, or, when necessary, for other control water consistent with the requirements for "experimental water" as described in Standard Methods for the Examination of Water and Wastewater. As a minimum, compliance with this objective shall be evaluated with a 96-hour bioassay. • In addition, effluent limits based on acute biotoxicity tests of effluents will be prescribed where appropriate; additional numerical receiving water quality objectives for specific toxicants will be established as sufficient data become available; and source control of toxic substances will be encouraged.

Exhibit 2-1. Existing Regional Water Board Toxicity Provisions	
Regional Water Board	**Basin Plan Toxicity Provisions**
Lahontan (6)	• All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life. • The survival of aquatic life in surface waters subjected to a waste discharge, or other controllable water quality factors, shall not be less than that for the same water in areas unaffected by the waste discharge, or when necessary, for other control water consistent with the requirements for "experimental water" as defined in Standard Methods for the Examination of Water and Wastewater. • For acute toxicity, compliance shall be determined by short-term toxicity tests on undiluted effluent using an established protocol. • For chronic toxicity, compliance shall be determined using the critical life stage toxicity tests. At least three approved species shall be used to measure compliance with the toxicity objective: a vertebrate, an invertebrate, and an aquatic plant. After an initial screening period, monitoring may be reduced to the most sensitive species.
Colorado River (7)	• All waters shall be maintained free of toxic substances in concentrations which are toxic to, or which produce detrimental physiological responses in, human, plant, animal, or indigenous aquatic life. • Effluent limits based on bioassays of effluent will be prescribed where appropriate, additional numerical receiving water objectives for specific toxicants will be established as sufficient data become available, and source control of toxic substances will be encouraged. • The survival of aquatic life in surface waters subjected to a waste discharge or other controllable water quality factors, shall not be less than that for the same water in areas unaffected by the waste discharge, or other control water which is consistent with the requirements for "experimental water" as described in Standard Methods for the Examination of Water and Wastewater. As a minimum, compliance with this objective shall be evaluated with a 96-hour bioassay.
Santa Ana (8)	• Toxic substances shall not be discharged at levels that will bioaccumulate in aquatic resources to levels which are harmful to human health. • The concentrations of toxic substances in the water column, sediments, or biota shall not adversely affect beneficial uses. • The Regional Water Board requires the initiation of a TRE if a discharge consistently exceeds its chronic toxicity effluent limit. The Regional Water Board, to date, has interpreted the "consistently exceeds" trigger as the failures of three successive monthly toxicity tests, each conducted on separate samples. Initiation of a TRE has also been conditioned on a determination that a sufficient level of toxicity exists to permit effective application of the analytical techniques required by a TRE.

Exhibit 2-1. Existing Regional Water Board Toxicity Provisions	
Regional Water Board	**Basin Plan Toxicity Provisions**
San Diego (9)	• All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life. • The survival of aquatic life in surface waters subjected to a waste discharge or other controllable water quality factors, shall not be less than that for the same water in areas unaffected by the waste discharge or, when necessary, for other control water consistent with requirements specified in EPA, State Water Board, or other protocol authorized by the Regional Water Board. As a minimum, compliance with this objective shall be evaluated with a 96-hour acute bioassay. • Effluent limits based on acute bioassays of effluents will be prescribed where appropriate, additional numerical receiving water objectives for specific toxicants will be established as sufficient data become available, and source control of toxic substances will be encouraged.

In addition, the provisions in the SIP supplement Basin Plan requirements; they do not supersede existing Regional Water Board toxicity requirements.

The SIP contains minimum chronic toxicity control requirements for implementing the narrative toxicity objectives for aquatic life protection contained in Regional Water Board Basin Plans. Under the SIP, Regional Water Boards impose chronic toxicity limits for discharges that have the reasonable potential (RP) to cause instream chronic toxicity. Compliance with toxicity objectives and limits is determined through short-term chronic toxicity tests performed on at least three test species (a plant, an invertebrate, and a vertebrate) during a screening period, after which the most sensitive species can be used alone.

If repeated toxicity tests reveal toxicity or if a discharge causes or contributes to chronic toxicity in a receiving water body, the SIP requires that dischargers perform a toxicity reduction evaluation (TRE) study, which may include a toxicity identification evaluation (TIE). The TRE study is used to identify the sources of toxicity, after which the discharger must take all reasonable steps necessary to eliminate the toxicity. Permit writers should then assign chemical-specific permit limits for pollutants identified by the TRE. Failure to comply with required toxicity testing and TRE studies within a designated period will result in the addition of chronic toxicity limits in the permit or appropriate enforcement action.

2.2 Affected Dischargers

The types of discharges potentially affected by the Amendment include NPDES-permitted dischargers (municipal and industrial wastewater dischargers, storm water discharges, and irrigated agriculture).

2.2.1 Municipal and Industrial Wastewater Dischargers

In municipal wastewater effluents, toxicity has been attributed to several chemicals commonly found in or added during treatment including chlorine used for disinfection, and ammonia produced from the breakdown of organic substances (SETAC, 2004). Indirect industrial or

commercial dischargers may also contribute to effluent toxicity if discharging toxic chemicals in violation of pretreatment limits or that are not removed with conventional wastewater treatment controls. In addition, toxicity may result from household chemicals that are improperly disposed of down the drain, including organic solvents and pesticides or commonly used soaps and detergents that can be highly toxic if inadequately treated prior to discharge.

In industrial wastewater, effluent toxicity can result from the use of chemicals known as biocides (e.g., chlorine) added to control nuisance biological growth in plumbing or cooling water systems (SETAC, 2004). Also, ions such as potassium, magnesium, and calcium can be toxic when the ions are added or taken out of water during various industrial processes (SETAC, 2004). Industrial chemicals or byproducts, if not treated properly, can cause effluent toxicity as well.

Most pollutants in the effluents of municipal and industrial wastewater treatment facilities that may cause instream acute or chronic toxicity are currently regulated through the NPDES permit program. However, effluents may still be toxic despite compliance with existing permit limits due to interactions of regulated pollutants as well as the presence of unregulated pollutants (alone or in combination).

There are 465 individually permitted facilities (not including storm water) that discharge to inland surface waters, enclosed bays, and estuaries in California (U.S. EPA, 2012). Of these facilities, approximately 60% are minor discharges. Data in EPA's integrated compliance information system (ICIS-NPDES) database indicate that most major dischargers have effluent limits and/or monitoring requirements for acute and chronic toxicity in their NPDES permits; data on limits and effluent data in ICIS-NPDES for minor dischargers is limited. However, the form of the effluent limits (e.g., narrative or numeric) and the monitoring frequencies vary significantly among dischargers.

Exhibit 2-2 summarizes these facilities.

Exhibit 2-2. Summary of Potentially Affected Facilities

Discharger Category	Number of Dischargers[1]	
	Major Dischargers	Minor Dischargers
Municipal Wastewater	148	70
Chemicals and Allied Products	1	3
Metals Manufacturing and Finishers	1	1
Petroleum Refineries	9	11
Pulp and Paper	1	12
Other Industrial	27	181
Total	187	278

1. Source: U.S. EPA (2012).

2.2.2 Storm Water Dischargers

Regional Water Boards regulate most storm water discharges under general permits. General permits often require compliance with standards through an iterative approach based on storm water management plans (SWMP), rather than through the use of numeric effluent limits. In

other words, permittees implement management practices and best management practices (BMPs) identified in their SWMPs. Then, if those BMPs do not result in attainment of water quality standards, Regional Water Boards would require additional practices until pollutant levels are reduced to the necessary levels. Because Regional Water Boards use this iterative approach that increases requirements until water quality objectives are met, current levels of implementation may not reflect the maximum level of control required to meet existing standards. The State Water Board has four existing programs for controlling pollutants in storm water runoff to surface waters: municipal, industrial, construction, and California Department of Transportation (Caltrans).

Municipal

The State Water Board's municipal program regulates storm water discharges from municipal separate storm sewer systems (MS4s). The MS4 permits require the discharger to develop and implement a SWMP, with the goal of reducing the discharge of pollutants to the maximum extent practicable (MEP). MEP is the performance standard specified in Section 402(p) of the Clean Water Act. The management programs specify BMPs addressing public education and outreach; illicit discharge detection and elimination; construction and post-construction; and good housekeeping. In general, medium and large municipalities must conduct chemical monitoring, but not small municipalities.

Larger MS4s usually represent a group of copermittees encompassing an entire metropolitan area. There are 22 area-wide medium and large MS4 permitted discharges in California that discharge, at least in part, to inland waters, enclosed bays, or estuaries (SWRCB, 2012). Some of the permittees monitor chronic and/or acute toxicity in receiving waters; others monitor specific pollutants identified as causing toxicity (e.g., diazinon and chlorpyrifos). **Exhibit** 2-3 shows existing toxicity requirements in permits for large and medium MS4s.

Exhibit 2-3. Toxicity Requirements in Large and Medium MS4 Permits[1]

Region	Name (NPDES #)	Requirements
1	Santa Rosa and County of Sonoma (CA0025038)	Chronic tests twice per year during storm events, three locations in receiving waters and downstream from discharge outfalls; test species shall be *Pimephales promelas*, *Ceriodaphnia dubia*, and *Selenastrum capricornutum*.
2	San Francisco Bay Regional (CAS612008)	U.S. EPA three species toxicity tests: *Selenastrum* growth and *Ceriodaphnia* and *Pimephales* with lethal and sublethal endpoints; also *Hyalella azteca* with lethal endpoint twice per year (1 dry season and 1 storm event). If toxicity results < 50% of control results, repeat sample. If 2nd sample yields < 50% of control results, initiate a TRE.
3	Salinas (CA0049981)	Monitoring background and receiving water sites for chronic toxicity once during the first runoff of the wet season, one more runoff event, and twice during dry weather for *Ceriodaphnia dubia*, *Pimephales promelas*, and *Selenastrum capricornutum*. If receiving water samples are toxic, the permittee shall conduct a TRE.
4	Long Beach (CAS004003)	Multiple species toxicity testing (*Americamysis bahia*, *Ceriodaphnia dubia*, and (*Strongylocentrotus purpuratus*) and TIE studies as part of study of Los Angeles and San Gabriel River Watersheds.

Exhibit 2-3. Toxicity Requirements in Large and Medium MS4 Permits[1]		
Region	**Name (NPDES #)**	**Requirements**
4	County of Los Angeles (CAS004001)	Multiple concentration chronic WET tests from two storm events and two dry weather events from each station per year for one freshwater (*Ceriodaphnia dubia*) and one marine (*Strongylocentrotus purpuratus*) species. A TIE should be conducted if any sample is above 1 TUc. Once pollutants causing at least 50% of toxic responses are identified through TIE, a TRE should be conducted.
4	Ventura County (CAS004002)	Toxicity monitoring during at least one storm per year until baseline information has been collected, and then discontinue. A TIE shall be performed when acute toxicity results are greater than 1 TUa (conducted on the most sensitive of fathead minnow and *Ceriodaphnia dubia*) or chronic toxicity tests result in exceedances in (1) two consecutive wet weather samples or (2) any dry weather flow sample.
5	Bakersfield-Kern County (CA00883399)	Narrative receiving water limit; no specific toxicity monitoring requirements.
5	Contra Costa Clean Water (CA083313)	Toxicity monitoring twice per year with one event during dry season and one event during a storm event at a minimum of two sites. If toxicity results < 50% of control results, repeat sample. If 2nd sample yields < 50% of control results, conduct a TRE.
5	Fresno (CA0083500)	Narrative receiving water limit; no specific toxicity monitoring requirements.
5	Modesto (CAS083526)	Chronic toxicity monitoring of *Pimephales promelas* and *Ceriodaphnia dubia*. If 100% mortality is detected, must conduct dilution series; if statistically significant toxicity is detected and a greater than or equal to 50% increase in either mortality, or reduction in reproduction compared to the control is observed, then TIEs shall be conducted on the initial sample that caused toxicity.
5	Port of Stockton (CAS084077)	Chronic toxicity monitoring of *Pimephales promelas* and *Ceriodaphnia dubia*. If 100% mortality is detected, must conduct dilution series; if statistically significant toxicity is detected, then TIEs shall be conducted on the initial sample that caused toxicity.
5	Sacramento (CAS082597)	Conduct toxicity testing at each receiving water station during two of the five fiscal years of the Order including samples from two storm events and one during the dry season from each receiving water station; species should be *Pimephales promelas* and *Ceriodaphnia dubia*. If 100% mortality is detected within 24 hours of test initiation, then a dilution series shall be initiated. If statistically significant toxicity is detected and there is more than a 50% increase in mortality compared to the laboratory control, then TIEs shall be conducted; a TRE shall be conducted whenever a toxicant is successfully identified through the TIE.
5	Stockton and San Joaquin County (CAS083470)	Chronic toxicity monitoring of *Pimephales promelas* and *Ceriodaphnia dubia*. If 100% mortality is detected, must conduct dilution series; if statistically significant toxicity is detected and a greater than or equal to 50% increase in either mortality, or reduction in reproduction compared to the control is observed, then TIEs shall be conducted on the initial sample that caused toxicity.

Exhibit 2-3. Toxicity Requirements in Large and Medium MS4 Permits[1]		
Region	**Name (NPDES #)**	**Requirements**
6	South Lake Tahoe, El Dorado and Placer County (CAG616001)	Narrative toxicity provision. For acute toxicity, compliance shall be determined by short-term toxicity tests on undiluted effluent using an established protocol. For chronic toxicity, compliance shall be determined using the critical life stage toxicity tests. At least three approved species shall be used to measure compliance with the toxicity objective. If possible, test species shall include a vertebrate, an invertebrate, and an aquatic plant. After an initial screening period, monitoring may be reduced to the most sensitive species. Dilution and control waters should be obtained from an unaffected area of the receiving waters.
7	Riverside County (CAS617002)	No toxicity provisions.
8	Orange County (CAS618030)	*Ceriodaphnia dubia* and *Strongylocentrotus purpuratus* shall be used to evaluate toxicity from the first rain event, plus one other wet weather sample and two dry weather samples; TIEs and TREs if monitoring indicates studies are needed.
8	Riverside County (CAS618033)	*Ceriodaphnia dubia*, *Pimephales promelas*, and *Selenastrum capricornutum* shall be used to evaluate toxicity on the sample from the first rain event, plus one other wet weather sample. In addition, where applicable, collect two dry weather samples or propose equivalent procedures in the CMP. Identify criteria which will trigger the initiation of TIEs and TREs.
8	San Bernardino County (CAS618036)	Collect a minimum of one sample per year during the dry weather index period using *Ceriodaphnia dubia* or *Hyalella azteca* if conductivity is too high for survival of control organisms.
9	Orange County (CAS108740)	Toxicity testing must be conducted for each monitoring event at each station.
9	Riverside County (CAS108766)	The Permittees shall analyze all storm samples (at least three annually) using three species: *Ceriodaphnia dubia* (water flea); *Hyalella azteca* (freshwater amphipod); and *Pseudokirchneriella subcapitata*, (unicellular algae). TIEs shall be used to determine the cause of toxicity, and TREs shall be used to identify sources and implement management actions to reduce pollutants in urban runoff causing toxicity.
9	San Diego (CAS108758)	The following toxicity testing shall be conducted for each monitoring event at each station as follows: (1) 7-day chronic test with *Ceriodaphnia dubia* (2) Chronic test with the freshwater algae *Selenastrum capricornutum* (3) Acute survival test with amphipod *Hyalella azteca*. TIEs shall be conducted to determine the cause of toxicity.

CMP = Coordinated Monitoring Program
NPDES = National Pollutant Discharge Elimination System
RMP = Regional Monitoring Program
SFEI = San Francisco Estuary Institute
TIE = Toxicity identification evaluation
TRE = Toxicity reduction evaluation
TU = toxicity unit (chronic or acute)
1. Permits at http://www.swrcb.ca.gov/water_issues/programs/stormwater/phase_i_municipal.shtml. Accessed May 2012.

The State Water Board adopted a general permit for smaller municipalities, including nontraditional small MS4s such as military bases, public campuses, and prison and hospital complexes. To date, 206 of the over 211 small MS4s covered by the statewide general permit have submitted SWMPs to Regional Boards or the State Water Board for approval. Few of these permittees currently monitor for toxicity as part of their SWMPs.

Industrial

Under the industrial program, the State Water Board issues a general NPDES permit that regulates discharges associated with ten broad categories of industrial activities. This general permit requires the implementation of management measures that will achieve the performance standard of best available technology economically achievable (BAT) and best conventional pollutant control technology (BCT). The permit also requires that dischargers develop a Storm Water Pollution Prevention Plan (SWPPP) and a monitoring plan. Through the SWPPP, dischargers are required to identify sources of pollutants, and describe the means to manage the sources to reduce storm water pollution. For the monitoring plan, facility operators may participate in group monitoring programs to reduce costs and resources.

Construction

The construction program requires dischargers whose projects disturb one or more acres of soil or whose projects disturb less than one acre but are part of a larger common plan of development that in total disturbs one or more acres to obtain coverage under the storm water general permit for construction activity. The construction general permit requires the development and implementation of a SWPPP that lists BMPs the discharger will use to protect storm water runoff and the placement of those BMPs. Additionally, the SWPPP must contain a visual monitoring program; a chemical monitoring program for nonvisible pollutants to be implemented if there is a failure of BMPs; and a sediment monitoring plan if the site discharges directly to a water body impaired for sediment.

The permit also contains specific toxicity provisions for active treatment system[1] dischargers. Any of these dischargers operating in batch treatment mode must initiate acute toxicity testing using *Pimephales promelas* or *Oncorhynchus mykiss* for effluent samples representing effluent from each batch prior to discharge. The permit does not contain specific toxicity requirements for any other discharger types.

Caltrans

Caltrans is responsible for the design, construction, management, and maintenance of the state highway system, including freeways, bridges, tunnels, Caltrans' facilities, and related properties. Before July 1999, storm water discharges from Caltrans' storm water systems were regulated by individual NPDES permits issued by the Regional Water Boards. On July 15, 1999, the State Water Board issued a statewide permit (Order No. 99-06-DWQ) which regulated all storm water discharges from Caltrans-owned MS4s, maintenance facilities and construction activities.

[1] An active treatment system is a treatment system that employs chemical coagulation, chemical flocculation, or electro-coagulation in order to reduce turbidity caused by fine suspended sediment

The existing permit allows Caltrans to implement BMPs rather than require compliance with numeric effluent limits. The BMPs must reflect pollutant reduction based on either MEP (MS4s) or BAT/BCT (construction activities), whichever is applicable. In addition, if receiving water quality standards are exceeded, Caltrans is required to submit a written report providing additional BMPs or other measures to be taken that will be implemented to achieve water quality standards. The permit also requires Caltrans to develop and implement a SWMP describing the procedures and practices used to reduce or eliminate the discharge of pollutants to storm drainage systems and receiving waters.

2.3 Irrigated Agricultural Lands

Agricultural activities that may affect aquatic life can be caused by (SWRCB, 2006b):

- Farming activities that cause excessive erosion, resulting in sediment entering receiving waters
- Improper use and over application of pesticides
- Over application of irrigation water resulting in runoff of sediments and pesticides.

Agricultural dischargers do not receive NPDES permits. In California, the Water Boards regulate discharges from irrigated land including storm water runoff, irrigation tailwater, and tile drainage through WDRs or waivers of WDRs. CWC Section 13269 allows the Regional Water Boards to waive WDRs if it is in the public interest.

Most historical waivers require that discharges not cause violations of water quality objectives, but do not require water quality monitoring. In 1999, Senate Bill 390 amended CWC Section 13269 and required Regional Water Boards to review and renew waivers or replace them with WDRs by January 1, 2003; otherwise, the waivers expired.

The Central Coast, Los Angeles, Central Valley, and San Diego Regional Water Boards have established conditional waivers for agricultural discharges. Central Coast Regional Water Board's waiver requires monitoring focused on nutrients and toxicity. Toxicity testing is used to determine if applied pesticides and other constituents are impacting beneficial uses. More detailed characterization, involving additional toxicity testing, chemical analysis, analysis of pesticide application data, and/or TIEs are required as necessary in areas where toxicity problems are documented (CCRWQCB, 2012).

The Los Angeles Regional Water Board's conditional waiver requires dischargers to determine the most sensitive species for toxicity monitoring and use the results to trigger further investigations into the cause of toxicity. Dischargers must implement a TIE when there is more than 50% mortality in any test. In addition, if Basin Plan or CTR objectives or total maximum daily load (TMDL) allocations are not attained, the waiver requires that the discharger submit a Corrective Action Plan that identifies time-specific management modifications (LARWQCB, 2010).

Central Valley Regional Water Board issues both group and individual waivers for agricultural growers with emphasis on group participation. Under the group and individual waivers, growers must implement management practices, as necessary, to improve and protect water quality and to

achieve compliance with applicable water quality standards. The waivers require that water column toxicity analyses be conducted on 100% (undiluted) samples for the initial screening. If toxicity is detected, the grower must initiate, at a minimum, a Phase I TIE to determine the general class (e.g., metals, non-polar organics, and polar organics) of the chemical causing toxicity (CVRWQCB 2006a; 2006b). Growers may also use Phase II TIEs to confirm and identify toxicant(s).

The San Diego Regional Water Board adopted a conditional waiver for agricultural and nursery operations requiring these dischargers to implement BMPs to minimize or eliminate the discharge of pollutants and form or join a monitoring group by December 31, 2010. Operators must also prevent the direct or indirect discharge of products used in operations (e.g., pesticides) into surface waters (SDRWQCB, 2007).

The Santa Ana Regional Water Board is proposing that all operators of irrigated or dry-farmed land, and other agricultural or livestock operations not already regulated by the Regional Water Board, enroll in the Conditional Waiver for Agricultural Discharges (CWAD) program. The CWAD program allows agricultural operators to discharge waste to waters of the state from their operations, provided they also comply with TMDLs by paying implementation fees, taking steps to implement BMPs to reduce the pollutant load of their discharge, and regularly report and monitor water quality (SARWQCB, 2009). The CWAD program will allow some conditions to be met through the collective action of a group or groups of agricultural operators who are enrolled in the program, or by a third party representing a coalition of enrollees. Agricultural operators who do not enroll in the program will be required to apply for individual WDRs, and will have full responsibility for their own compliance (SARWQCB, 2009).

The North Coast Water Board is developing a program to include irrigated lands in the North Coast Region and address discharges of waste to waters of the State. The State Water Board expect the Program to address, at a minimum, waste discharges from lands uses such as irrigated row crops, vineyards, orchards, and irrigated pasture. This effort is intended to augment, but not supersede, existing Regional Water Board programs addressing discharges from irrigated lands, such as the TMDL programs.

San Francisco Bay Water Board staff is developing a conditional waiver for vineyard properties in the Napa and Sonoma watersheds to require that effective management practices be implemented to control human-caused discharges of pollutants from vineyard facilities. The vineyard waiver would cover existing vineyards, vineyard replants, as well as new vineyard development. The Regional Water Board also adopted a conditional waiver for grazing operations in the Napa River and Sonoma Creek watersheds on September 14, 2011. The goals of the waiver are to reduce the discharge of sediment and pathogens to the Napa River and Sonoma Creek, and to protect stream and riparian areas. This program is a key element to implementing TMDLs for these two watersheds.

The Colorado Regional Water Board has a conditional prohibition for agriculture in its Basin Plan as part of TMDL implementation, and the Lahontan Regional Water Board does not have waivers for agricultural discharges.

Exhibit 2-4 summarizes baseline regional toxicity monitoring programs for agricultural dischargers.

Exhibit 2-4. Regional Agricultural Toxicity Monitoring Programs
Region 3 (Central Coast)
• Conduct the following water column toxicity tests for each site, twice in the dry season and twice in the wet season: (1) 4-day test with the algae *Selenastrum capricornutum* (2) 7-day chronic test with the water flea *Ceriodaphnia* (3) 7-day chronic test with the fathead minnow *Pimephales promelas*. At sites where persistent unresolved toxicity is found, the Executive Officer may require a TIE. • Conduct the following sediment toxicity tests for each site: (1) 10-day test with *Hyalella azteca*, annually (2) Benthic Invertebrate and associated Physical Habitat Assessment following SWAMP standard operating procedures, once during the second year of Order concurrent with sediment toxicity sampling.
Region 4 (Los Angeles)
• Conduct chronic toxicity tests for the three test species: (1) fathead minnow, *Pimephales promelas* (2) water flea, *Ceriodaphnia* (3) green algae, *Selenastrum capricornutum*. After one toxicity sample has been collected and analyzed in the first year, the most sensitive species is to be selected for subsequent toxicity monitoring. • Schedule toxicity tests once during the wet season and once during the dry season. • Annual monitoring consisting of 4 sampling events: 2 in the dry season and 2 in the wet season.
Region 5 (Central Valley)
• Conduct water column toxicity tests for the following species: (1) *Ceriodaphnia dubia* (2) *Pimephales promelas* (3) *Selenastrum capricornutum*. • If a 50% or greater difference in *Ceriodaphnia dubia* or *Pimephales promelas* mortality, or a 50% or greater reduction in *Selenastrum capricornutum* growth, as compared to the laboratory control, is detected at any time in an acceptable test, a TIE is required within 48 hours. • If within the first 96 hours of the initial toxicity screening, the mortality reaches 100%, initiate a multiple dilution test. The dilution series must be initiated within 24 hours of the sample reaching 100% mortality, and must include a minimum of five (5) sample dilutions in order to quantify the magnitude of the toxic response. • Daily sample water renewals shall occur during all acute toxicity tests to minimize the effects of rapid pesticide losses from test waters. • A feeding regime of 2 hours prior to test initiation and 2 hours prior to test renewal shall be applied.
SWAMP = Surface Water Ambient Monitoring Program TIE = Toxicity Identification Evaluation

3 Description of Amendment

This section describes the toxicity Amendment which supersedes the numeric toxicity objectives and implementation provisions for toxicity in the Basin Plans. The Amendment does not supersede the narrative toxicity objectives established in the Basin Plans.

3.1 Objectives

The Amendment establishes toxicity objectives applicable to all inland surface waters, enclosed bays, and estuaries to protect freshwater and saltwater aquatic life.

3.1.1 Chronic Toxicity

The chronic toxicity objective is expressed as a null hypothesis and a regulatory management decision (RMD) of 0.75 for chronic toxicity methods, where the following null hypothesis shall be used:

$$H_o: \text{ Mean response (IWC)} \leq 0.75 \cdot \text{mean response (control)}$$

Attainment of the water quality objective is demonstrated by rejecting this null hypothesis in accordance with the TST statistical method.

3.1.2 Acute Toxicity

The acute toxicity objective is expressed as a null hypothesis and an RMD of 0.80 for acute toxicity methods, where the following null hypothesis shall be used:

$$Ho: \text{ Mean response (IWC)} < 0.80 \bullet \text{mean response (control)}$$

Attainment of the water quality objective is demonstrated by rejecting this null hypothesis in accordance with the TST statistical method.

3.2 Implementation Procedures

The Amendment establishes minimum requirements for implementing the numeric toxicity objectives that apply to discharges to inland surface waters, enclosed bays, and estuaries covered under NPDES permits, WDRs, or the irrigated lands regulatory program. The requirements supersede existing Regional Water Board Basin Plan requirements.

3.2.1 Reasonable Potential

The Amendment requires all dischargers to conduct a minimum of four WET tests for each species prior to permit issuance and reissuance. Chronic WET test species must, at a minimum, include one aquatic plant, one vertebrate, and one invertebrate. Acute WET tests may also be required by the applicable Water Board; these tests must, at a minimum, include one vertebrate and one invertebrate. WET test results must be analyzed using the Test of Significant Toxicity (TST; U.S. EPA, 2010), and dischargers must send the results to the appropriate Regional Water Board for RP determination. Dischargers may submit any WET data generated during the current

permit term provided it meets all Amendment requirements to the Regional Water Boards for the RP analysis.

Due to the uncertainty of influent constituents and volume of discharges, all wastewater treatment plants (WWTPs) authorized to discharge at a rate greater than or equal to 5 million gallons per day (mgd) have RP under the Amendment. Thus, the RP monitoring results serve to identify or confirm the test species most sensitive to these fluctuating discharges.

For industrial dischargers and WWTPs with flows less than 5 mgd, if a WET test result is a "fail," or the test result is a "pass" and the mean effect is greater than 10%, the discharger has RP and will receive a numeric permit limit for chronic or acute WET and a requirement for routine effluent monitoring for WET. If the WET test result is a "pass" and the mean effect is 10% or less, a numeric effluent limit is not required. The mean effect is calculated as the difference between the mean control response and the mean response at the IWC divided by the mean control response.

3.2.2 Effluent Limits

The Amendment requires that Regional Water Boards apply the objectives for chronic WET directly in permits as numeric limits expressed as a maximum daily effluent limitation (MDEL), and a median monthly effluent limitation (MMEL) for dischargers with RP. The Water Board also may, at its discretion, include a numeric limit for acute toxicity, also to be expressed as an MDEL and an MMEL. MDEL is an effluent limit based on the outcome of the TST statistical test and the percent effect. The MDEL is exceeded when a toxicity test, using the TST, results in a fail, and the percent effect is greater than or equal to 50% for chronic toxicity tests or 40% for acute toxicity tests. MMEL is an effluent limit based on the median TST statistical results of three independent toxicity tests taken within the same calendar month. The MMEL is exceeded when the median TST result (i.e. two out of three) is "Fail."

3.2.3 Mixing Zones

To the extent authorized by the applicable Basin Plan, a permitting authority may grant a mixing zone for toxicity. Allowance of a mixing zone is discretionary. If a Regional Water Board grants a mixing zone, the objectives for toxicity shall be met throughout the receiving water except within the mixing zone.

3.2.4 Routine Monitoring

The Amendment requires dischargers with RP to conduct routine WET monitoring using the test species that demonstrates the highest level of sensitivity during RP screening. Routine WET monitoring includes a minimum of a single test consisting of the IWC and a control. Continuous dischargers authorized to discharge greater than 5 mgd must conduct one chronic WET test every calendar month. Major seasonal and intermittent dischargers must conduct monthly testing only during periods of discharge lasting 15 or more days. Facilities authorized to discharge less than 5 mgd must monitor for WET on a quarterly basis, with seasonal and intermittent dischargers conducting quarterly WET tests only during periods of discharge lasting 15 or more days. If required, dischargers shall also conduct acute toxicity monitoring at intervals determined by the

applicable Water Board. . Water Boards also may, at their discretion, require periodic monitoring for chronic or acute toxicity of NPDES wastewater and point source WDR dischargers even in the absence of RP.

Rates of discharge are calculated based on daily rates for a representative period of time prior to permit reissuance or reopening. New POTW permits will use dry weather design capacity as a flow rate value, and existing sources will use the highest expected rate of discharge. Calculation of non-continuous dischargers' rates of discharge will not include any days where discharge does not occur.

3.2.5 Compliance

A chronic toxicity test result indicating a "fail" with a percent effect at or above 0.50 is an exceedance of the chronic MDEL. An acute toxicity test result indicating a fail with a percent effect at or above 0.40 is an exceedance of the acute MDEL. Upon exceedance of an MDEL, continuous dischargers may implement corrective action if the source of toxicity is known (e.g. operational upset) and confirm the corrective action with an additional toxicity test, conducted within the same calendar month. Non-continuous NPDES wastewater dischargers and point source WDR dischargers must conduct a verification toxicity test during the next period of discharge. The verification test must result in a "pass". If this toxicity test fails at any percent effect, the discharger will proceed to accelerated monitoring.

If a toxicity test results in a "fail," but the percent effect is below the MDEL, dischargers shall conduct two additional toxicity tests within the same calendar month in order to determine compliance with the MMEL. If either of these two additional tests results in a "fail," the median monthly result is "fail" and the discharger will be in exceedance of the MMEL.

At a minimum, an accelerated monitoring schedule must consist of four multiple-concentration WET tests, conducted at approximately two-week intervals, over an eight-week period. The test species used for accelerated monitoring must be the most sensitive species used during routine toxicity monitoring.

If a test "fails" during accelerated monitoring with a percent effect at or above 0.25 for chronic tests or 0.20 for acute tests, the discharger is obligated to conduct a TRE in order to characterize and control the toxic constituents in the discharge The discharger must conduct a TRE in accordance with a TRE Work Plan developed pursuant to the requirements of the applicable Water Board.

3.2.6 Compliance Schedules

The applicable Water Board has the discretion to grant a compliance schedule to NPDES wastewater and point source WDR dischargers in order to achieve the objectives. Compliance schedules must be consistent with the State Water Board's Policy for Compliance Schedules in National Pollutant Discharge Elimination System Permits, with the exception that the duration of the compliance schedule may not exceed two years from the date of permit issuance, reissuance, or reopening to address toxicity requirements after the effective date of the Amendment. The discretion to grant compliance schedules, however, will expire ten years after the effective date

of the Amendment. In addition, dischargers operating under existing NPDES wastewater permits or point source WDRs containing toxicity monitoring requirements are not eligible to receive a compliance schedule.

3.2.7 Exemptions

The Amendment exempts small communities and insignificant dischargers from the effluent limits, routine monitoring, and compliance provisions of the Amendment unless the applicable Water Board finds them to have an impact on receiving water quality.[2] Small communities are communities with populations of 20,000 or less, and a median household income (MHI) below 80% of the statewide MHI. Insignificant dischargers have an insignificant impact on receiving water quality and must discharge less than one mgd on a non-continuous basis.

The Amendment also allows the Water Boards, after compliance with CEQA, to grant short-term or seasonal exceptions from meeting the toxicity objectives if determined to be necessary to implement control measures either:

- For resources or pest management (e.g. vector or weed control, pest eradication, or fishery management) conducted by public entities or mutual water companies to fulfill statutory requirements, including, but not limited to, those in the California Fish and Game, Food and Agriculture, Health and Safety, and Harbors and Navigation codes; or
- Regarding drinking water conducted to fulfill statutory requirements under the federal Safe Drinking Water Act or the California Health and Safety Code. Such categorical exceptions may also be granted for draining water supply reservoirs, canals, and pipelines for maintenance, for draining municipal storm water conveyances for cleaning or maintenance, or for draining water treatment facilities for cleaning or maintenance.

In addition, where site-specific conditions in individual water bodies or watersheds differ sufficiently from statewide conditions and those differences cannot be addressed through other provisions of this Amendment, the State Water Board may, in compliance with CEQA, subsequent to a public hearing, and with the concurrence of the U.S. EPA, grant an exception to meeting the toxicity objectives or any other provision of the Amendment where the State Water Board determines:

- The exception will not compromise protection of enclosed bay, estuarine, and inland surface waters for beneficial uses; and
- The public interest will be served.

The Amendment also states that industrial NPDES wastewater dischargers that are required to conduct weekly acute flow-through toxicity testing may be required to take alternative approaches to established provisions regarding acute testing, monitoring, and compliance determination. These industrial NPDES wastewater dischargers must still comply with the water

[2] However, nothing in the Policy precludes the applicable Water Board from requiring periodic toxicity testing for small communities.

quality objectives established in the Amendment and all established chronic toxicity testing provisions.

3.2.8 Storm Water

Under the Policy, all MS4s and individual industrial storm water dischargers subject to existing toxicity monitoring requirements will be required to analyze toxicity data using the TST method and to report results as a "pass" or "fail."

3.2.9 Other Dischargers Required to Monitor Toxicity

Under the Amendment, other dischargers subject to existing toxicity monitoring requirements under a conditional waiver or nonpoint source WDR will be required to analyze toxicity data using the TST method and to report results as a "pass" or "fail." In addition, the Amendment recommends, but does not require, the implementation of chronic toxicity monitoring programs for these other dischargers not currently required to do so. Remediation is recommended if these dischargers "fail" a test.

4 Method for Evaluating Compliance and Costs

This section describes the method for evaluating compliance with the Amendment and estimating incremental cost impacts. **Appendix A** contains the detailed analyses for NPDES point sources and the attached spreadsheets provide the data used in the analyses.

4.1 Municipal and Industrial Wastewater

The method for evaluating potential impacts of the Amendment for municipal and industrial wastewater dischargers is based on a sample of facilities and involves determining RP, evaluating compliance with revised effluent limits based on analyzing existing data using the TST, determining the necessary compliance mechanisms, and estimating the cost of those mechanisms.

4.1.1 Identifying Potentially Affected Facilities

There are a total of 465 (218 municipal WWTP and 247 industrials) individually-permitted NPDES dischargers that discharge wastewaters to inland surface waters, enclosed bays, and estuaries in California. However, some of these dischargers are exempt from routine monitoring, sensitive species testing, and effluent limit requirements in the Amendment. For example, small communities, defined as having populations less than 20,000 and MHI less than 80% of the state average MHI. Abt Associates excluded small communities from this analysis as unlikely to incur incremental costs associated with the Amendment.

To identify small communities, Abt Associates first assumed that any municipal WWTP with a flow (as reported in EPA's PCS database in August 2008) greater than 3 mgd is likely serving more than 20,000 people based on a maximum of 150 gallons of water per day per person (typical water consumption is 75 to 130 gallons per person per day; Metcalf and Eddy, 2003). Abt Associates then used facility names to match Census population and MHI data to identify small communities. Abt Associates assumed that any community with less than 20,000 people and MHI greater than 80% of the state average MHI would not be small. Thus, Abt Associates identified 53 municipal WWTPs (21 majors and 32 minors) likely to be classified as small communities and exempt from the Amendment.

4.1.2 Selecting a Sample

Most of the dischargers potentially affected by the Amendment currently have WET provisions in their permits. However, minor dischargers are not as likely as majors to discharge toxic pollutants in toxic amounts. For example, the State Water Board and EPA are reclassifying one major industrial facility as a minor discharger because it had substantially improved operations and effluent quality. Minor municipal dischargers have, by definition, capacities below 1 million gallons per day (mgd); they also treat wastewater primarily from the residential sector which is not likely to contain as many toxics as indirect industrial and commercial dischargers, if any.

Thus, compliance analysis of the affected major dischargers is likely to capture most, if not all, of the potential compliance-related costs.[3]

Factors that may affect the potential magnitude of compliance costs include:

- Facility type (municipal/industrial)
- Flow (for process controls)
- Industrial processes
- Dilution allowances.

The CWA requires municipal dischargers to have secondary treatment or an equivalent, and most major WWTPs treat wastewater from a combination of residential, commercial, and industrial sources. Thus, treatment controls are likely to be similar across municipal dischargers. Larger flows are typically associated with the largest treatment costs, although per-unit costs may decrease due to economies of scale.

For industrial dischargers, minimum treatment requirements vary based on the type of industry. Treatment processes and potential effluent quality also vary based on industry type. Categories of concern for WET include chemical manufacturers, metal manufacturers and finishers, petroleum refineries, and pulp and paper mills. Indeed, effluent data from major dischargers in California in EPA's ICIS-NPDES database indicate that some of the facilities in these categories have violated current toxicity permit limits.

The availability of dilution may also be indicative of compliance costs. In waters for which mixing zones would not be allowed (e.g., ephemeral and low flow streams, impaired water bodies), the IWC would be based on 100% effluent samples. Ephemeral and low flow streams are more common in the southern region of the state due to a drier climate. However, impairments in the San Francisco and Delta region may also preclude mixing zones.

Given these considerations, to evaluate potential compliance costs Abt Associates evaluated the potential impact of the Amendment on major facilities using the sample SAIC selected for analysis of the draft Amendment. For major municipal dischargers, SAIC selected the largest facility in the north and the largest facility in the south to incorporate the facilities with highest potential for cost in the two regions.[4] For remaining municipal facilities, SAIC selected a representative sample based on flow (five facilities).

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[3] Analysis of major facilities also likely captures the bulk of incremental monitoring costs. Available permits from different Regions indicate a wide range of existing WET monitoring requirements for minors, including frequencies of none to monthly; for either acute or chronic to both; and using single- and multiple-concentration tests. Under the Policy, requirements are standardized to include quarterly single-concentration monitoring of either chronic or chronic and acute tests. Under a worst case scenario of a minor POTW having no existing toxicity monitoring requirements and then being required to monitor for chronic toxicity quarterly using single-concentration tests, annual costs could be approximately $2,400 (based on average of *Pimephales promelas*, *Ceriodaphnia dubia*, and *Selanastrum capricornutum*). However, given the variability of existing monitoring requirements and the fact that many minor facilities may meet the small community exemption, incremental monitoring costs would be minimal.

[4] Because the probability of selecting each of the facilities was one (100%), these two facilities represent a certainty sample.

To reflect the importance of industrial type for major industrial discharges, SAIC selected a stratified random sample using five industrial categories: chemicals products, metals manufacturers and finishers, petroleum refineries, pulp and paper mills, and other industries.

Exhibit 4-1 summarizes the facilities by discharge category.

Exhibit 4-1. Summary of Potentially Affected Facilities and Sample

Discharger Category	Number of Dischargers	
	Total Major Dischargers[1]	Sample for Evaluation
Municipal Wastewater	127	7
Chemicals and Allied Products	1	1
Metals Manufacturing and Finishers	1	1
Petroleum Refineries	9	2
Pulp and Paper	1	1
Other Industrial	27	2
Total	166	14

1. Source: U.S. EPA (2008).

Exhibit 4-2 lists the sample facilities.

Exhibit 4-2. Summary of Sample Facilities

NPDES Number	Name	Discharge Category	Flow (mgd)[1]
Certainty Sample			
CA0077682	Sacramento Regional Sanitation District WWTP	Municipal	181
CA0053911	LA County Sanitation District, San Jose Creek WRP (East and West)	Municipal	100
Municipal Wastewater			
CA8000304	San Bernardino WWTP	Municipal	28
CA0102822	Victor Valley Regional WWTP	Municipal	14
CA0079049	Davis WWTP	Municipal	7.5
CA0048127	Lompoc Regional WWTP	Municipal	5
CA0059501	Camrosa Water District WWTP	Municipal	1.5
Industrial Wastewater			
CA0004910	Dow Chemical Corporation, Pittsburg Plant	Chemicals and Allied Products	0.5
CA0005002	USS POSCO Industries	Metal Manufacturing and Finishing	20
CA0005789	Shell Oil, Martinez Refinery	Petroleum Refinery	2.7
CA0005134	Chevron, Richmond Refinery	Petroleum Refinery	13
CA0004821	Pactiv Corporation, Molded Pulp Mill	Pulp and Paper	20
CA0004111	Aerojet General Corporation, Sacramento Facility[2]	Other	35.8
CA0059188	Department of Water Resources, Warne Power Plant	Other	1.75

mgd = million gallons per day
WRP = water reclamation plant
WWTP = wastewater treatment plant
1. Source: U.S. EPA (2008).
2. Compliance not evaluated due to data issues.

4.1.3 Evaluating Compliance with Existing Requirements

The method for evaluating compliance with existing WET requirements for the sample facilities involves obtaining NPDES permits and toxicity test results, evaluating existing monitoring requirements, and determining the frequency of toxicity violations, exceedance of monitoring triggers, and exceedance of TIE/TRE triggers, if applicable.

Current permit requirements range from narrative or numeric acute and/or chronic limitations to accelerated monitoring and/or TIE/TRE triggers only. The expression of limits and triggers also range from thresholds for single test results to median values for a series of consecutive tests. Limits and triggers for some facilities reflect dilution credits while those for other facilities do not.

Evaluation of existing permit requirements is necessary to determine the incremental impacts of the Amendment. Baseline compliance actions would need to be undertaken even in the absence of the Amendment. Thus, only those actions above and beyond baseline activities are attributable to the Amendment.

4.1.4 Determining Reasonable Potential under the Amendment

Under the Amendment, all major WWTPs have RP to cause or contribute to instream toxicity. For major industrial facilities, Abt Associates estimated RP based on data from 2006 through 2008 analyzed using the TST (as a proxy for the potential outcome of the acute or chronic WET tests submitted to the Regional Water Board for RP determination under the Amendment) and the mean effect. Under the Amendment, mean effects greater than 10% indicate potential to contribute to instream toxicity and thus, RP.

4.1.5 Evaluating Compliance under the Amendment

For all WWTPs and industrial facilities in the sample with RP, Abt Associates evaluated potential compliance with chronic effluent limits under the Amendment based on three years of existing data (2006 through 2008) analyzed using the TST. For those facilities that may receive dilution, Abt Associates evaluated compliance based on the percent of effluent that corresponds to the dilution ratio. For example, for 10:1 dilution, compliance is based on comparing the 10 percent effluent sample to the control using the TST method. In cases of data not reflecting the exact IWC, Abt Associates evaluated the effluent percentages closest to the actual IWC and estimated a range of compliance scenarios if necessary.

Under the Amendment, any chronic test evaluated using the TST method that results in a "fail" with a percent effect greater than 50% is an exceedance of the chronic MDEL. Assessing compliance with the chronic MMEL is only necessary when tests result in a "fail" with a percent effect less than 50%.

4.1.6 Estimating Potential Compliance Mechanisms

The potential for incremental actions under the Amendment reflects a comparison of compliance with current permit requirements compared to the Amendment. Under the Amendment, there may be incremental differences in monitoring frequencies and test types (e.g., chronic or acute;

single-concentration or multiple-concentration tests) that could result in additional costs or cost savings. For example, under the Amendment, only chronic monitoring is required; permit writers have the discretion to include acute monitoring if they deem such testing necessary.

However, current NPDES permit regulations indicate that effluent limits should be based on the more stringent of acute or chronic long term averages. With toxicity, long term averages based on chronic toxicity tests are the more stringent in most cases. In addition, the Amendment requires permit writers to justify in the permit why both acute and chronic toxicity limits would be necessary which would result in the permit being subject to petition and review by the State Board. Thus, for this analysis Abt Associates assumed that dischargers will only receive chronic toxicity monitoring requirements.

In addition to changes in monitoring requirement, incremental differences in test evaluation may result from use of the TST compared to the statistical evaluations currently in use. For the sample facilities, Abt Associates compared the current (baseline) and Amendment results to identify potential changes in compliance status.

To identify compliance actions under the Amendment, Abt Associates first identified all samples that could exceed the chronic MDEL (i.e., "fail" with percent effect at or above 50%) or result in the need to assess compliance with the MMEL (i.e., "fail" with percent effect below 50%). For all toxicity tests except those using *Ceriodaphnia dubia*, Abt Associates determined "pass"/ "fail" status using Welch's t-test, as specified in the Amendment. For chronic toxicity tests using *Ceriodaphnia dubia,* Abt Associates determined "pass"/ "fail" status based on the percent effect. As specified in the Amendment, a percent effect less than 25% constitutes a "pass," and a percent effect equal to or greater than 25% constitutes a "fail."

Then, depending on data availability, Abt Associates evaluated whether verification monitoring (to determine compliance with the MDEL) or additional monthly monitoring (to determine compliance with the MMEL) indicates a need for accelerated monitoring. Because accelerated monitoring results are not typically available for the sample facilities, Abt Associates conservatively (i.e., erring on the side of higher costs) assumed that accelerated monitoring results would indicate the need for a TRE. Abt Associates then compared the compliance actions under the Amendment with those that would be required under the existing permit; only those actions that would not also be needed for compliance with existing permit requirements are attributable to the Amendment.

Abt Associates also evaluated the potential for incremental costs to result from the need for facilities to add replicates to an analysis. The TST is designed to declare a chronic test toxic (i.e., a "fail") when the percent effect at the IWC is $\geq$25% compared to the control, and nontoxic (i.e., a "pass") when the mean percent effect at the IWC is $\leq$10% compared to the control. At effects between these boundaries (10% and 25% effect for chronic tests), the TST is designed to "pass" most tests if within-test variability is at or below the national average for the method. One way to lower within-test variability is for laboratories to add additional replicates to the test to ensure that results indicating toxicity truly represent the presence of toxicity in the effluent. However, the State Board (2011) found that the few cases of the TST indicating toxicity at effects less than

the toxic RMD but above the nontoxic RMD are due to high variability between replicates in the controls and/or IWC treatments (SWRCB, 2011). The State Board (2011) found that adding a minimal number of replicates to these tests would have resulted in the sample being declared nontoxic using the TST procedure in most cases. Thus, Abt Associates assumed that incremental costs associated with the addition of replicates would be minimal.

Monitoring Costs

Incremental monitoring costs could result from routine, verification/follow-up, or accelerated monitoring. The California Department of Health Services (DHS) has accredited 75 laboratories under the Environmental Laboratories Accreditation Program (ELAP) to perform WET tests. These laboratories have demonstrated capability to analyze environmental samples using approved methods (CA DHS, 2012). The accredited laboratories include both commercial and university testing facilities.

Unit costs vary with species and test type (e.g., acute or chronic, single-concentration or multiple dilutions). In addition, laboratories may offer discounts related to the number of tests or longer turnaround times, or charge additional fees related to delivery charges, shorter turnaround times, or the type of control water (laboratory water versus ambient water).

Some municipal and industrial dischargers with DHS-accredited laboratories collect samples and perform toxicity tests onsite. These dischargers may not keep record of per sample testing costs; rather, testing costs may be rolled up into the facility's operating budget. Presumably, both municipal and private industrial dischargers perform in-house testing because it is less expensive than contracting the work out to a commercial or university laboratory, or they want to perform the tests themselves. Thus, price information from commercial and university laboratories establishes market costs relevant to the potential impacts of changes in WET test requirements; these prices may overstate costs to dischargers using in-house laboratories.

Exhibit 4-3 shows acute and chronic toxicity test species and methods for fresh and marine waters.

Exhibit 4-3. Aquatic Toxicity Test Types

Common Name (Species)	EPA Method	Endpoint	Test Type
Freshwater Acute Tests			
Fathead minnow (*Pimephales promelas*)	2000.0	Mortality	Static, renewal, or flow-through
Water flea (*Ceriodaphnia dubia*)	2002.0	Mortality	Static, renewal, or flow-through
Rainbow trout (*Oncorhynchus mykiss*)	2019.0	Mortality	Static, renewal, or flow-through
Brook trout (Salvelinus fontinalis)	2019.0	Mortality	Static, renewal, or flow-through
Water flea (*Daphnia magna*)	2021.0	Mortality	Static, renewal, or flow-through
Water flea (*Daphnia pulex*)	2021.0	Mortality	Static, renewal, or flow-through
Freshwater Chronic Tests			

Exhibit 4-3. Aquatic Toxicity Test Types			
Common Name (Species)	**EPA Method**	**Endpoint**	**Test Type**
Fathead minnow (*Pimephales promelas*)	1000.0	Larval survival and growth	Renewal
Water flea (*Ceriodaphnia dubia*)	1002.0	Survival and reproduction	Renewal
Green alga (*Selenastrum capricornutum*)	1003.0	Growth	Static
Marine Acute Tests			
Sheepshead minnow (*Cyprinodon variegatus*)	2004.0	Mortality	Static, renewal, or flow-through
Bannerfish shiner (*Cyprinella leedsi*)	2004.0	Mortality	Static, renewal, or flow-through
Inland silverside (*Menidia beryllina*)	2006.0	Mortality	Static, renewal, or flow-through
Silverside (*Menidia menidia*)	2006.0	Mortality	Static, renewal, or flow-through
Silverside (*Menidia peninsulae*)	2006.0	Mortality	Static, renewal, or flow-through
Mysid (*Mysidopsis bahia*)	2007.0	Mortality	Static, renewal, or flow-through
Topsmelt (*Atherinops affinis*)	NA	Mortality	Static, renewal, or flow-through
West Coast mysid (*Holmesimysis costata*)	NA	Mortality	Static, renewal
Marine Chronic Tests			
Pacific Oyster (*Crassostrea gigas*) and Mussel (*Mytilus sp.*)	1005.0	Larval development	Renewal
Topsmelt (*Atherinops affinis*)	1006.0	Survival and growth	Renewal
West Coast Mysid (*Holmesimysis costata*)	1007.0	Survival and growth	Renewal
Purple Urchin (*Strongylocentrotus purpuratus*)	1008.0	Fertilization	Static
Giant Kelp (*Macrocystis pyrifera*)	1009.0	Germination and germ tube growth	Static
Purple Urchin (*Strongylocentrotus purpuratus*)	NA	Embryo development	Static
Red abalone (*Haliotis rufescens*)	NA	Larval development	Static
Sources: U.S. EPA (2002a); U.S. EPA (2002b); U.S. EPA (2002c); U.S. EPA (1995). NA = not applicable.			

Abt Associates collected toxicity test price information from a number of the California DHS-accredited laboratories, as summarized in **Exhibit** 4-4

Exhibit 4-4. Summary of WET Test Costs						
Test Method and Species	Multiple-Concentration			Single-Concentration		
	N	Range (2012 $)	Average (2012 $)	N	Range (2012 $)	Average (2012 $)
Acute						
EPA Method 2000.0 - *Cyprinodon variegatus*	2	$370 - $410	$390	4	$260 - $420	$330
EPA Method 2000.0 - *Oncorhynchus mykiss*	2	$370 - $410	$390	4	$260 - $420	$330
EPA Method 2000.0 - *Pimephales promelas*	11	$225 - $800	$527	19	$180 - $600	$352
EPA Method 2002.0 - *Ceriodaphnia dubia*	9	$275 - $800	$590	12	$180 - $600	$372
EPA Method 2004.0 - *Cyprinodon variegatus*	3	$500 - $750	$667	1	$300	$300
EPA Method 2006.0 - *Menidia beryllina*	6	$390 - $850	$686	4	$195 - $638	$421
EPA Method 2006.0 - *Menidia menidia*	2	$750	$750	0	ND	ND
EPA Method 2006.0 - *Menidia peninsulae*	2	$750	$750	0	ND	ND
EPA Method 2007.0 - *Mysidopsis bahia*	5	$500 - $775	$675	3	$300 - $500	$383
EPA Method 2019.0 - *Oncorhynchus mykiss*	5	$400 - $959	$712	11	$260 - $450	$387
EPA Method 2019.0 - *Salvelinus fontinalis*	2	$750	$750		ND	ND
EPA Method 2021.0 - *Daphnia magna*	2	$450 - $750	$600	8	$250 - $563	$402
EPA Method 2021.0 - *Daphnia pulex*	1	$900	$900	1	$675	$675
N/A - *Atherinops affinis*	4	$395 - $850	$655	4	$200 - $638	$422
N/A - *Holmesimysis costata*	2	$750	$750		ND	ND
Chronic						
EPA Method 1000.0 - *Pimephales promelas*	2	$1,200 - $1,250	$1,225	1	$600	$600
EPA Method 1002.0 - *Ceriodaphnia dubia*	7	$1,071 - $1,450	$1,237	5	$450 - $1,088	$674
EPA Method 1003.0 - *Selenastrum capricornutum*	6	$700 - $1,250	$920	4	$350 - $938	$547
EPA Method 1005.0 - *Crassostrea gigas or Mytilus sp.*	3	$1,400 - $2,200	$1,817	2	$1,050 - $1,300	$1,175
EPA Method 1006.0 - *Atherinops affinis*	6	$1,070 - $1,450	$1,237	5	$550 - $1,088	$698
EPA Method 1007.0 - *Holmesimysis costata*	2	$1,250 - $1,850	$1,550	1	$500	$500
EPA Method 1008.0 - *Strongylocentrotus purpuratus*	4	$855 - $1,500	$1,078	3	$430 - $825	$562
EPA Method 1009.0 - *Macrocystis pyrifera*	4	$1,200 - $1,850	$1,438	3	$600 - $1,125	$808
N/A - *Haliotis rufescens*	5	$960 - $2,000	$1,502	4	$480 - $1,200	$845
N/A - *Strongylocentrotus purpuratus*	3	$1,400 - $2,200	$1,700	3	$430 - $1,300	$927
ND = not cost data available N/A = no method number specified N = number of per test costs available from certified commercial and university labs performing WET tests						

In addition, costs for three-species chronic WET testing to determine the most sensitive species are needed for those sample facilities not currently conducting such tests. **Exhibit** 4-5 summarizes these costs based on average species type costs for freshwater and marine tests.

Exhibit 4-5. Average Costs for Three-Species Chronic WET Tests

Test Type	Single-Concentration	Multiple-Concentration
Freshwater 3-species[1]	$1,542	$3,344
Marine 3-species[2]	$2,322	$4,227

1. Based on the sum of average costs of *Ceriodaphnia dubia*, *Pimephales promelas*, and *Selenastrum capricornutum*
2. Based on the sum of average costs of *Atherinops affinis, Macrocystis pyrifera*, and the combined average of *Crassostrea gigas or Mytilus sp,, Haliotis rufescens, Holmesimysis costata, and Strongylocentrotus purpuratus.*

Based on responses from laboratories, Abt Associates determined that the cost for adding an additional replicate could range from $0 to $125 (Denton, 2012; Heise, 2012). Assuming that most dischargers would require an additional 1-2 replicates, per sample costs could increase by $0 - $250 per test (SWRCB, 2011). However, the purpose of adding replicates to toxicity tests would be to reduce costs associated with false positives resulting in toxicity limit violations (e.g., accelerated monitoring and TREs). That is, dischargers would likely only add replicates to save costs. Therefore, adding replicate costs should reduce the more costly accelerated monitoring and possibly TREs that could be needed to address permit violations, which could decrease the overall incremental costs for a given facility. Because of the potential for cost savings, Abt Associates did not include replicate costs in estimates for municipal and industrial dischargers.

In addition, Abt Associates did not include costs associated with sample collection and shipping in the per test unit costs. For major POTWs required to monitor chronic toxicity monthly under the Amendment, information from the sample facilities indicates that these dischargers all likely have monthly monitoring requirements for other pollutants. For minor POTWs required to monitor chronic toxicity quarterly under the Amendment, available permits indicate that most facilities are currently required to conduct quarterly monitoring for conventional pollutants (e.g., BOD, TSS, bacteria). Thus, the WET samples under the Amendment can be collected at the same time as other pollutant samples with minimal additional effort. For those dischargers that do not use in-house laboratories, sample transportation and shipping costs are likely the same in that the additional WET samples can be shipped with other samples for a minimal additional cost. Therefore, Abt Associates did not include an estimate of incremental labor and transportation costs of the Amendment.

Toxicity Reduction Evaluation Unit Costs

If accelerated monitoring indicates a fail at or above the toxic RMD of 0.20 for acute or 0.25 for chronic then the Amendment requires dischargers to conduct a TRE. EPA defines a TRE as a site-specific study conducted in a stepwise process designed to identify the causative agents of effluent toxicity, isolate the sources of toxicity, evaluate the effectiveness of toxicity control options, and confirm the reduction in effluent toxicity (U.S. EPA, 1991). TREs comprise all measures taken to reduce WET to required levels. TREs can involve many steps and are seldom the same for all situations. Major components of a TRE include (U.S. EPA, 1999):

- Information and data acquisition
- Facility performance evaluation
- Toxicity identification evaluation
- Toxicity source evaluation
- Toxicity control evaluation
- Toxicity control implementation.

The exact components of a TRE will vary for each discharger. For example, if toxicity occurred after the addition of a new treatment chemical or process change, the investigation can likely be conducted in-house and for a minimal cost. However, in many situations simply examining operational records is of little value without knowledge of the specific toxicant causing the problem (Pillard and Hockett, 2002). Identifying the toxicant of concern often increases treatment and control options while decreasing total control costs.

A TIE is a set of procedures that uses physical and chemical treatments to identify or classify the specific chemical compounds causing toxicity in an effluent sample (U.S. EPA, 2001). EPA recommends that permittees conduct TIEs early in the TRE process (U.S. EPA, 2001). TIE procedures are commonly performed in three phases: characterization, identification, and confirmation. The phases can be performed sequentially (using the results of one phase to influence the next) or simultaneously. TIE costs vary based on effluent complexity and the number of phases conducted. For example, Nautilus Environmental (2012) indicates that a Phase I TIE would cost $5,000 to $7,000; however, costs for Phase II and III TIEs are site-specific. GEI Consultant indicates that Phase I TIE costs vary, but are approximately an additional $100 to $250 per test, depending on effluent manipulations required, data review needs, etc. (GEI Consultants, 2012).

The difficulty in conducting a TIE, and the time required to complete it, will likely increase in direct proportion to the complexity of toxicants in wastewater. As the number of chemical constituents in wastewater increases, the interactions of those chemicals (e.g., with biological and analytical systems and with each other in the wastewater) can increase the difficulty of identifying toxicants (U.S. EPA, 2001). However, TIE studies do not need to be prohibitively expensive. ENSR indicates that relatively low-cost investigations can be extremely useful in providing cost-effective solutions to effluent toxicity problems (Pillard and Hockett, 2002).

Based on TIE results, the permittee may decide to conduct treatability tests on the effluent or source investigations to determine the appropriate control actions. However, not all TREs need to include TIEs. In some cases, dischargers may first conduct treatability tests that use bench-scale treatment units to identify process changes that reduce toxicity through changes in treatment type, arrangement, or method. While these tests may not identify which toxicant is being removed or reduced, they can still be effective in reducing WET.

Costs for a TRE (not including implementation of specific control actions) can range from $25,000 to $40,000 (Pillard and Hockett, 2002). For example, the City of Bryan (Texas) received bids from two laboratory service providers to perform a TRE of $36,222 and $28,560, plus up to

an additional $5,000 for all 3 phases of a TIE. For this analysis, Abt Associates used a TRE cost of $40,000 to be conservative (i.e., err on the side of higher costs).

Process Controls

EPA considers any technically reasonable actions taken to resolve WET as TRE activities (EPA, 2001). Such actions may include chemical substitution/addition, process optimization or enhancements, pretreatment modifications, or treatment of process streams.

Chemical substitution removes the source of toxicity in effluents. Common chemicals for which substitution may be an option include cooling tower slimicides, ammonia nutrients, lime, polymers, and oxidizing agents (U.S. EPA, 1989). Adding chemicals to the treatment process may also improve toxicant or toxicity removal. EPA (1999) provides a number of examples:

- Nutrients can be added to influent wastewaters that have low nutrient levels (relative to their organic strength) to improve biological treatment
- Lime or caustic chemicals can be used to adjust wastewater pH for optimal biological treatment or for coagulation and precipitation treatment
- Other chemical coagulants are used to aid in removal of insoluble toxicants and to improve sludge settling
- Powdered activated carbon may be applied in activated sludge systems to remove toxic organic compounds.

Process optimization entails modifying existing operations and facilities to improve operation, maintenance, and performance (Metcalf and Eddy, 2003). Optimization usually involves two main steps: process analysis and process modifications. Process analysis is an investigation of the performance-limiting factors of the treatment process and is a key factor in achieving optimum treatment efficiency. Process modifications include activities short of adding new treatment technology units (conventional or unconventional) to the treatment train. For example, modifications could include modifying baffles, adding chemicals to enhance coagulation and solids removal, equalizing flow, training operators, and installing automation equipment including necessary hardware and software. Potential modifications vary based on the type of facility and existing treatment train.

The primary advantages of pretreatment control of toxicity are that a smaller volume of waste can be managed by addressing individual sources and the costs are usually the responsibility of the industrial users. Pretreatment requirements may involve a public education effort or the implementation of narrative or numerical limitations for dischargers to WWTPs. If the problem toxicant is not already regulated under the existing pretreatment program, municipalities may need to (U.S. EPA, 1999):

- Investigate public education approaches, if the toxicant is widely used in the service area (e.g., organophosphate insecticides)
- Perform an allowable headworks loading analysis
- Decide whether to establish local limits or implement a more directed approach, such as industrial user management or case-by-case requirements
- Develop a monitoring program to evaluate compliance with the requirements.

Treatment of wastewater is another option for controlling effluent toxicity. However, end-of-pipe treatment can be costly, making dischargers more likely to first pursue lower cost options such as process optimization and pollution prevention (e.g., chemical substitution and pretreatment modifications). The treatment technology selected will depend on the toxicant of concern. For example, enhanced biological nutrient removal technologies target reductions in nutrients such as ammonia, whereas, reverse osmosis primarily removes dissolved contaminants (e.g., mercury and pesticides).

Exhibit 4-6 provides examples of the types of control actions that may be necessary for different discharger categories. Note that unit costs for these actions are not readily available, and Abt Associates could not develop unit costs for these specific actions due to a lack of site-specific data for each facility and activity.

Exhibit 4-6. Examples of WET Control Actions			
Discharger Category	**Pollutants of Concern**	**Control Actions**	**Source**
Municipal wastewater	Copper	Implemented additional pretreatment controls/requirements	U.S. EPA (1999)
Municipal wastewater	Diazinon and chlorpyrifos	Public awareness program; source control program; identify processes and operations that remove organophosphate insecticides	U.S. EPA (1999)
Municipal wastewater	Surfactants	Pretreatment to minimize or eliminate industrial chemicals	U.S. EPA (1999)
Municipal wastewater	Ammonia, non-polar organic compounds, surfactants	Developed pretreatment limits specific to ammonia and general toxicity limits for non-ammonia pollutants	U.S. EPA (1999)
Municipal wastewater	Bacteria regrowth in effluent samples	Replaced old auto samplers; revised sample tubing replacement protocol; optimized sample collection to reduce bacterial growth	SRCSD (2008)
Petroleum refinery	Organic chemicals	Installed granular activated carbon to treat 5-10 mgd (in addition to existing biological treatment)	Calgon Carbon (no date)
Petroleum refinery	Semi-volatile aromatics, high MW aliphaties, substituted phenols, aromatic amine and indole compounds, long-chain fatty acid esters, and substituted PAHs	Added more aeration horsepower to combined equalization/aeration tank; modified secondary clarifiers; and added new permanent pumps, piping, instrumentation, and controls for return and waste activated sludge flow control	Stover and Walls (2004)
Petroleum refinery	Neutral organic Chemicals	Ammonia recovery and foul water stripper; preliminary bench scale testing indicated that activated carbon will reduce final effluent toxicity to acceptable levels	U.S. EPA (1989)
Steel production	Bacteria	Improved housekeeping and increased frequency of clarifier cleaning and floc removal	Hall and Lockwood (2004)
Latex production	Mixture of nitrite and ammonia	Upgrades in solids pretreatment and the biological nitrification system (i.e., an anoxic basin and additional nitrification)	Hall and Lockwood (2004)
Organic chemicals	Calcium and chloride salts	Implemented source controls	Hall and Lockwood (2004)
Gas-fired power plant	Copper	Using commercial additive containing EDTA chelating agent	ENSR (2008)

Control costs are highly site-specific. However, in general, pretreatment modifications, source controls, and process optimization are less costly to implement than end-of-pipe treatment. As shown in the exhibit, in certain cases, such as removal of organics from petroleum refinery wastewater, end-of-pipe treatment may be the most technologically and economically feasible alternative for compliance.

4.1.7 Estimating Potential Incremental Statewide Costs

To estimate total statewide costs, Abt Associates calculated average per facility costs for each discharger category by dividing total compliance costs for the sample facilities by the number of sample facilities in each discharger category. Abt Associates then multiplied average per facility costs by the total number of facilities in the applicable category. Note that because WET monitoring costs are not likely to vary based on flow, Abt Associates did not extrapolate the estimated incremental costs for the sample facilities to all facilities based on a cost per mgd of flow. In comparison, costs for compliance technologies to reduce WET would likely be related to flow. However, Abt Associates did not estimate process control costs for the sample facilities.

4.2 Storm Water Discharges

Under the Amendment, the only change to permit requirements for MS4 permittees and individual industrial storm water dischargers with existing toxicity monitoring requirements is that toxicity data must be analyzed using the TST method. There are no toxicity monitoring data from storm water dischargers from which to determine the change in compliance actions for storm water dischargers under the Amendment and thus, the incremental controls that may be needed under the Amendment. However, the State Water Board (2011) evaluated storm water samples collected during dry weather, storm events, and irrigation seasons in agricultural areas and found that using the TST method is not expected to result in a change in the number of enforcement actions compared to use of the current toxicity methods.

While enforcement actions may not change under the Amendment, monitoring requirements could increase for certain dischargers. For Phase I MS4s, only three of the 21 permittees do not currently have toxicity monitoring provisions. Assuming permit writers would require yearly chronic toxicity monitoring consisting of four single-concentration tests for the Phase I MS4s without existing monitoring provisions, incremental annual costs could be approximately $2,900 per year per permittee, or $8,700 per year total for all three permittees. **Exhibit** 4-7 summarizes these potential incremental costs.

Exhibit 4-7. Potential Incremental Phase I MS4 Monitoring Costs

Name (NPDES #)	Existing Toxicity Monitoring Requirements	Annual Incremental Cost[1]
Santa Rosa and County of Sonoma (CA0025038)	Yes	$0
San Francisco Bay Regional (CAS612008)	Yes	$0
Salinas (CA0049981)	Yes	$0
Long Beach (CAS004003)	Yes	$0
County of Los Angeles (CAS004001)	Yes	$0
Ventura County (CAS004002)	Yes	$0
Bakersfield-Kern County (CA00883399)	No	$2,900
Contra Costa Clean Water (CA0083313)	Yes	$0
Fresno (CA0083500)	No	$2,900
Modesto (CAS083526)	Yes	$0
Port of Stockton (CAS084077)	Yes	$0
Sacramento (CAS082597)	Yes	$0
Stockton and San Joaquin County (CAS083470)	Yes	$0

Exhibit 4-7. Potential Incremental Phase I MS4 Monitoring Costs		
Name (NPDES #)	Existing Toxicity Monitoring Requirements	Annual Incremental Cost[1]
South Lake Tahoe, El Dorado and Placer County (CAG616001)	Yes	$0
Riverside County (CAS617002)	No	$2,900
Orange County (CAS618030)	Yes	$0
Riverside County (CAS618033)	Yes	$0
San Bernardino County (CAS618036)	Yes	$0
Orange County (CAS108740)	Yes	$0
Riverside County (CAS108766)	Yes	$0
San Diego (CAS108758)	Yes	$0
Total		$8,700
1. Represents average of chronic toxicity test prices ($717) multiplied by 4 samples per year for those permittees without existing toxicity monitoring requirements.		

Phase II MS4s are covered under a statewide general permit that contains specific water quality monitoring requirements based on the impairment status or sensitivity of the receiving waters. Thus, Abt Associates assumed that specific monitoring requirements would not likely change under the Amendment.

In addition, costs associated with incremental changes to monitoring requirements for individual industrial storm water dischargers are already captured in the industrial costs described above.

4.3 Other Dischargers Required to Monitor Toxicity

Under the Amendment, the only change to permit requirements for other dischargers regulated exclusively under the Porter-Cologne Water Quality Control Act required to monitor for toxicity under existing requirements is that toxicity data must be analyzed using the TST method. However, the State Water Board (2011) evaluated storm water samples collected during dry weather, storm events, and irrigation seasons in agricultural areas and found that using the TST method is not expected to result in a change in the number of enforcement actions compared to use of the current toxicity methods. There may be a need for these dischargers to add replicates to samples to decrease the likelihood of a "false positive." However, as discussed above, this may add anywhere from $0 to $250 per test but would be motivated by efforts to reduce total costs by avoiding accelerated monitoring and possibly TREs that could be needed to address violations.

The conditional waivers in the Central Coast, Los Angeles, and Central Valley regions already contain toxicity monitoring requirements and TRE/TIE provisions for addressing potential toxicity. Thus, to the extent that toxicity results analyzed using the TST method would remain unchanged, incremental compliance costs could be minimal in these regions.

The North Coast, San Francisco, Colorado River and San Diego Regional Water Boards' conditional waivers for agriculture do not contain any specific monitoring or control requirements for toxicity. Thus, if permit writers require specific toxicity provisions in the waiver as a result of the Amendment, there could be some incremental cost associated with

compliance. However, the magnitude of this incremental cost, if any, is uncertain due to uncertainty associated with baseline activities for individual growers and estimates of the number of growers covered by each waiver.

The Santa Ana Regional Water Board's conditional agriculture waiver is still being developed and implemented. Thus, it is uncertain whether baseline conditions would include toxicity monitoring provisions and whether incremental costs are likely. In addition, it is uncertain how many farmers are covered by the waiver and whether they would participate in the group or individual monitoring programs.

The Lahontan Regional Water Board does not currently have conditional waivers for agricultural lands. However, because all of the Regional Boards are required to implement an agriculture discharge program, the Amendment will apply to this region in the future. Whether those waivers would have included toxicity monitoring in the absence of the Amendment or whether permit writers will revise waivers to include monitoring provisions is uncertain.

5 Results

This section summarizes the potential incremental Amendment actions and statewide costs. Incremental impacts represent the costs of activities above and beyond those that would be necessary in the absence of the Amendment under baseline conditions. This section also discusses the limitations and uncertainties associated with the analysis.

5.1 Municipal and Industrial Wastewater

Exhibit 5-1 summarizes the potential incremental costs to the sample facilities of complying with the Amendment. Negative values represent cost savings associated with reduced WET testing requirements, and reduced accelerated monitoring and TRE activities associated with the change in statistical method, under the Amendment. Reduced monitoring costs are typically attributable to removing acute WET testing requirements. Reduced TRE costs may result if effluent data analyzed under existing methods trigger permit requirements to implement a TRE and no such requirements are triggered under the Amendment using the TST method.

Exhibit 5-1. Potential Incremental Amendment Costs for the Sample Facilities

Name	Monitoring[1]	Compliance Actions[2]	Total
Municipal Wastewater			
Sacramento Regional County Sanitation District WWTP	-$52,600	$0	-$52,600
Los Angeles County Sanitation District, San Jose Creek WRP (East and West)	-$3,900	-$15,000	-$18,900
Camrosa Water District WWTP	$0	$0	$0
Colton/San Bernardino RIX	-$6,400	-$14,400 to $400	-$20,800 to -$6,000
Davis WWTP	-$23,200	-$14,200 to $400	-$37,400 to -$22,800
Lompoc Regional WWTP	-$1,800	$0	-$1,800
Victor Valley Regional WWTP	$5,800	$400 to $15,200	$6,200 to $21,000
Industrials			
Aerojet	$4,800	ND	$4,800
Chevron, Richmond Refinery	-$5,800	$0	-$5,800
Pactiv Corporation, Molded Pulp Mill	-$5,500	$0	-$5,500
Dow Chemical Company	-$5,800	$0	-$5,800
DWR, Warne Power Plant	-$2,000 to $12,600	$0	-$2,000 to $12,600
Shell Oil, Martinez Refinery	-$200	$300 to $15,700	$100 to $15,500
USS POSCO Industries	-$4,100	-$1,400 to $13,900	$2,700 to $18,000

ND = No data to evaluate compliance
WRP = water reclamation plant
WWTP = wastewater treatment plant
1. Includes cost of routine monitoring and species sensitivity screening.
2. Includes cost of follow-up monitoring, accelerated monitoring, and TREs.

Based on the number of dischargers in each category (e.g., municipal wastewater, chemicals products, metals manufacturers and finishers, petroleum refineries, pulp and paper mills, and other industries), the results from the sample facilities can be extrapolated to estimate the potential incremental statewide costs associated with the Amendment.

Exhibit 5-2 shows the calculation of incremental statewide costs.

Exhibit 5-2. Extrapolation of Compliance Costs for Major Dischargers[1]					
Discharger Category	Total Cost to Sample Dischargers	Number of Sample Dischargers	Average Cost per Discharger	Number of Dischargers Statewide	Total Statewide Cost
Certainty Sample[2]	-$71,500	2	NA	2	-$71,500
Municipal Wastewater	-$53,800 to -$9,600	5	-$10,800 to -$1,900	125	-$1,350,000 to -$237,500
Chemicals and Allied Products	-$5,800	1	-$5,800	1	-$5,800
Metals Manufacturing and Finishers	$2,700 to $18,000	1	$2,700 to $18,000	1	$2,700 to $18,000
Petroleum Refineries	-$5,700 to $9,700	2	-$2,900 to $4,900	9	-$26,100 to $44,100
Pulp and Paper	-$5,500	1	-$5,500	1	-$5,500
Other Industrial	$2,800 to $17,400	2	$1,400 to $8,700	27	$37,800 to $234,900
Total	NA	14	NA	166	-$1,418,400 to -$23,300

Note: detail may not add to total due to independent rounding.
NA = not applicable
1. Includes cost of routine monitoring, follow-up monitoring, accelerated monitoring, and TRE implementation; does not include cost of treatment controls because information on specific pollutant(s) causing toxicity is not available.
2. Represents the largest facility in the north and the largest facility in the south to incorporate the facilities with highest potential for cost in the two regions.

5.2 Storm Water Dischargers

Incremental compliance costs to storm water discharges associated with additional enforcement actions due to a change in test analysis methods under the Amendment are unlikely based on the State Water Board (2011) comparison of toxicity results for storm water data using the TST method and current toxicity methods. However, there could be incremental costs to storm water dischargers that do not currently have toxicity monitoring requirements if permit writers implement a recommended monitoring program under the Amendment of approximately $8,700 per year.

5.3 Other Dischargers Required to Monitor Toxicity

Incremental costs to discharges from other dischargers required to monitor toxicity associated with additional enforcement actions due to a change in test analysis methods under the Amendment are unlikely based on the State Water Board (2011) comparison of toxicity results for storm water runoff from agriculture areas using the TST method and current toxicity methods. In addition, it is uncertain whether monitoring requirements would change under the Amendment.

5.4 Limitations and Uncertainties

There are a number of uncertainties associated with the analysis of potential compliance and costs under the Amendment due to data limitations. **Exhibit** 5-3 summarizes the key uncertainties and the potential effect on estimated costs.

Exhibit 5-3. Key Limitations and Uncertainties in the Analysis of Compliance and Costs		
Issue or Assumption	**Impact on Estimated Costs**	**Comments**
Treatment costs not estimated.	–	If a TRE is necessary, dischargers could incur some costs for reducing effluent toxicity. However, without information on the pollutants causing the toxicity, the magnitude of those costs cannot be estimated. It is unlikely that a significant number of dischargers, if any, would need to implement additional treatment controls under the Policy that would not already be needed to meet existing toxicity permit requirements.
Compliance with Amendment and thus estimated costs based on WET tests from 2006 through 2008.	?	Dischargers may test different species (due to rescreening and changes in acceptable test species) under the Amendment, which could change compliance results. Effluent quality may have changed over time.
Incremental costs associated with a change in monitoring requirements are not estimated for other dischargers required to monitor toxicity .	?	Costs to dischargers with existing toxicity provisions may be minimal or there may be cost savings. Dischargers with no existing toxicity provisions could incur costs if permit writers choose to include the recommended monitoring programs in permits; however, such costs could be offset by potential cost savings from other dischargers.
'?' = uncertain '-' = estimated costs may be understated		

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Appendix A: Facility Analyses

A.1 Aerojet-General Corporation

The following sections document the incremental compliance analysis for the sample facility.

A.1.1 Facility Information

The following exhibit summarizes general information about the facility.

General Information: Aerojet-General Corporation

Name	Aerojet-General Corporation
NPDES No.	CA0004111
Category	Major industrial (other)
Flow (mgd)	35.8
Receiving water	Buffalo Creek (Outfalls 001, 002, 003, and 004)
Existing treatment level	Primary
Existing treatment train	Retention ponds

A.1.2 Existing Permit Requirements

The following exhibit summarizes the existing permit requirements related to WET testing for the sample facility.

WET Permit Requirements: Aerojet-General Corporation

Permit issue date	7/31/2008
Permit expiration date	7/31/2013
Dilution	None
Acute monitoring	Twice per year; 1 species (*Pimephales promelas*)
Acute limits	None
Chronic monitoring	Annually; three species (*Ceriodaphnia dubia*, survival and reproduction test; *Pimephales promelas*, larval survival and growth test; *Selenastrum capricornutum*, growth test); 100% effluent
Chronic limits	None
Accelerated monitoring trigger	The numeric toxicity monitoring trigger is > 1 TUc (where TUc = 100/NOEC).
TIE/TRE trigger	If the result of any accelerated toxicity test exceeds the monitoring trigger, the Discharger shall cease accelerated monitoring and initiate a TRE to investigate the cause(s) of, and identify corrective actions to reduce or eliminate effluent toxicity.
Resume regular testing condition	If the results of four consecutive accelerated monitoring tests do not exceed the monitoring trigger, the Discharger may cease accelerated monitoring and resume regular chronic toxicity monitoring.

A.1.3 Compliance

Data are not available from which to evaluate compliance with baseline or Amendment requirements.

Abt Associates assumed that permit writers would not require routine acute monitoring under the Amendment, as shown in the table below. Chronic monitoring will be monthly, but with one species (most sensitive). In addition, there is no incremental cost associated with initial RP monitoring (chronic three-species testing) because the permit already requires three-species testing annually.

Routine Monitoring Costs: Aerojet-General Corporation

Component	Baseline	Amendment	Incremental
Acute			
Frequency	2/yr	NA	NA
# Species	1	NA	NA
Test type	Single concentration	NA	NA
Unit cost	$352 (*Pimephales promelas*)	NA	NA
Annual cost	$700	NA	-$700
Chronic			
Frequency	1/yr	12/yr	NA
# Species	3	1	NA
Test type	Single concentration	Single concentration	NA
Unit costs	$674 (*Ceriodaphnia dubia*) $600 (*Pimephales promelas*) $547 (*Selenastrum capricornutum*)	$607 (Uncertain[1])	NA
Annual cost	$1,800	$7,300	$5,500
Total			
Annual cost	$2,500	$7,300	$4,800

NA = not applicable.
1. Most sensitive species is uncertain; cost represents the average unit cost of single-concentration tests for *Ceriodaphnia dubia*, *Pimephales promelas*, and *Selenastrum capricornutum*.

Thus, total incremental costs for the discharger may be $4,800 per year.

Potential Total Annual Incremental Compliance Costs: Aerojet-General Corporation

Routine Monitoring	3-Species Sensitivity Monitoring	Permit Limit Compliance	Total Annual
$4,800	$0	$0	$4,800

A.2 Camrosa WRP

The following sections document the incremental compliance analysis for the sample facility.

A.2.1 Facility Information

The following exhibit summarizes general information about the facility.

General Information: Camrosa WRP

Name	Camrosa WRP
NPDES No.	CA0059501
Category	Major municipal
Flow (mgd)	1.5
Receiving water	Calleguas Creek
Existing treatment level	Tertiary
Existing treatment train	Bar screen, headworks lift station, denitrification extended aeration system, anoxic denitrification, secondary clarification, upflow sand filtration, chlorination, and impoundment for reclamation.

A.2.2 Existing Permit Requirements

The following exhibit summarizes the existing permit requirements related to WET testing for the sample facility.

WET Permit Requirements: Camrosa WRP

Permit issue date	12/4/2003
Permit expiration date	11/10/2008
Dilution	Not applicable
Acute monitoring	Quarterly; 1 species (*Pimephales promelas*); 100% effluent
Acute limits	Survival of aquatic organisms in 96-hour bioassays of undiluted waste shall be no less than 70% for one bioassay, and the average for any three or more consecutive bioassays shall be no less than 90%.
Chronic monitoring	Monthly; 1 species with re-screening every 15 months (*Ceriodaphnia dubia*, *Pimephales promelas*, *Selenastrum capricornutum*); 100% effluent
Chronic limits	Monthly median of 1.0 TUc (100/NOEC)
Accelerated monitoring trigger	Exceed either acute or chronic limits
TRE trigger	Any 2 of the 6 accelerated acute tests are less than 90% survival; the initial acute test and any of the additional 6 acute toxicity bioassay tests result in less than 70 % survival; or any 3 out of the initial chronic tests and the 6 accelerated tests exceed 1.0 TUc
Resume regular testing condition	If implementation of the initial investigation TRE Work Plan indicates the source of toxicity (e.g., a temporary plant upset, etc.), toxicity is in compliance with the limitations in all of the 6 additional tests required, or a TRE/TIE is initiated prior to completion of the accelerated testing schedule then the Discharger shall return to the normal sampling frequency

A.2.3 Baseline Compliance

There are no effluent toxicity data available for this facility because it has not discharged since 1998.

A.2.4 Amendment Compliance

There are no data available from which to determine compliance with the Amendment because the facility has not discharged to surface water since 1998.

A.2.5 Potential Incremental Impact Summary

The potential for compliance with WET requirements is similar under the Amendment compared to the current permit. Thus, incremental control costs are zero. In addition, monitoring costs are zero because the facility is not currently discharging.

A.3 Chevron, Richmond Refinery

The following sections document the incremental compliance analysis for the sample facility.

A.3.1 Facility Information

The following exhibit summarizes general information about the facility.

General Information: Chevron, Richmond Refinery

Name	Chevron, Richmond Refinery
NPDES No.	CA0005134
Category	Major industrial (petroleum refining)
Flow (mgd)	13
Receiving water	San Pablo Bay
Existing treatment level	Tertiary
Existing treatment train	The treatment system first consists of oil and water separators. Wastewater is then routed to a bioreactor that consists of 4 quadrants. The first 2 quadrants provide biological treatment through aeration, while the next 2 quadrants are used as settling basins. After the settling basins, the Discharger routes a portion of bioreactor effluent to its water enhancement wetland. The remaining bioreactor effluent, and typically all wetland effluent, is routed through granular activated carbon before discharge through a deepwater diffuser.

A.3.2 Existing Permit Requirements

The following exhibit summarizes the existing permit requirements related to WET testing for the sample facility.

WET Permit Requirements: Chevron, Richmond Refinery

Permit issue date	9/1/2011
Permit expiration date	8/31/2016
Dilution	10:1
Acute monitoring	Weekly; 1 species (*Oncorhynchus mykiss*)
Acute limits	The survival of organisms in undiluted effluent not less than an 11-sample median of not less than 90%, and an 11-sample 90th percentile value of not less than 70%.
Chronic monitoring	Quarterly; 1 species (*Ceriodaphnia dubia*); 100%, 50%, 25%, 10%, and 5%, and 2.5% dilutions; screening phase monitoring data from within 5 years of permit expiration date required in application for permit reissuance
Chronic limits	3-sample median < 10 TUc, and a single-sample value < 20 TUc.
Accelerated monitoring trigger	3-sample median >=10 TUc, or single-sample value >= 20 TUc. Accelerate frequency to monthly.
TRE trigger	Submit TRE work plan based on required generic Work Plan within 30 days of exceeding an accelerated monitoring trigger
Resume regular testing condition	If data from accelerated monitoring data points are found to be in compliance with the evaluation parameter, then regular monitoring shall be resumed.

A.3.3 Baseline Compliance

The following tables summarize WET data from 8/23/06 – 5/7/08. The 2011 permit revised chronic monitoring requirements to specify tests based on *Ceriodaphnia dubia* instead of *Macrocystis pyrifera*, however, due to a lack of more recent effluent data Abt Associates evaluated compliance with baseline permit requirements based on *Macrocystis pyrifera* data.

Baseline Compliance, Acute Toxicity: Chevron, Richmond Refinery

Species	*Oncorhynchus mykiss*
Test	Survival
# of tests	9
# exceeding limit[1]	0
1. Based on incomplete data from PCS.	

Baseline Compliance, Chronic Toxicity: Chevron, Richmond Refinery

Species	*Macrocystis pyrifera*
Test	Germination and growth
# of tests	8
# exceeding limit	0
# exceeding accelerated monitoring trigger	0
Exceeding TRE trigger? (Y/N)	N

The discharger is in compliance with existing permit limits and requirements.

A.3.4 Amendment Compliance

Regional Water Boards can allow dilution at their discretion. However, assuming that the facility would receive a dilution ratio of 10:1 as in the existing permit, the IWC would represent a 10% effluent sample.

The following table summarizes WET data from 8/23/06 – 5/7/08 under the Amendment based on comparison of 10% effluent sample to a control.

Effluent Data Analysis under the Amendment, Chronic Toxicity: Chevron, Richmond Refinery

Species	*Macrocystis pyrifera*
Test	Germination and growth
# of tests	8
# of fails	0
# with mean effect >10%	0
"fail" = statistically significant using the TST method	

Based on existing chronic monitoring data, the discharger would not have RP under the Amendment because there are no "fail" results and all of the test mean effects are below 10%.

A.3.5 Potential Incremental Impact Summary

The discharge is in compliance with baseline requirements and would not have RP (and thus, would not receive effluent limits or need controls) under the Amendment. Thus, incremental control costs are zero.

Abt Associates assumed that permit writers would continue to require flow-through acute monitoring under the Amendment, as shown in the table below, and no routine chronic monitoring is needed because the discharger does not have RP under the Amendment. In addition, incremental cost savings associated with initial RP monitoring (chronic three species testing) would likely be minimal because the permit already requires at least three multiple dilution tests per species for permit renewal (the Amendment requires four single concentration tests per species).

Routine Monitoring Costs: Chevron, Richmond Refinery

Component	Baseline	Amendment	Incremental
Acute			
Frequency	52/yr	52/yr	NA
# Species	1	1	NA
Test type	Single concentration	Single concentration	NA
Unit cost	$387 (*Oncorhynchus mykiss*)	$387 (*Oncorhynchus mykiss*)	NA
Annual cost	$20,100	$20,100	0
Chronic			
Frequency	4/yr	NA	NA
# Species	1	NA	NA
Test type	Multiple dilutions	NA	NA
Unit costs	$1,438 (*Macrocystis pyrifera*)	NA	NA
Annual cost	$5,800	NA	-$5,800
Total			
Annual cost	$25,900	$20,100	-$5,800
NA = not applicable.			

Thus, total incremental cost savings for the discharger may be approximately $5,800per year.

Potential Total Annual Incremental Compliance Costs: Chevron, Richmond Refinery

Routine Monitoring	3-Species Sensitivity Monitoring	Permit Limit Compliance	Total Annual
-$5,800	$0	$0	-$5,800

A.4 Colton/San Bernardino Regional Tertiary Treatment Facility

The following sections document the incremental compliance analysis for the sample facility.

A.4.1 Facility Information

The San Bernardino WWTP is a secondary plant that discharges (along with the Colton WWTP) to the Colton-San Bernardino Regional Tertiary Plant. Toxicity monitoring is required for the regional plant and not the individual plants. The following exhibit summarizes general information for the regional treatment facility.

General Information: Colton/San Bernardino Regional Tertiary Treatment Facility

Name	Colton/San Bernardino Regional Tertiary Treatment Facility
NPDES No.	CA8000304
Category	Major municipal
Flow (mgd)	28
Receiving water	Santa Ana River
Existing treatment level	Tertiary
Existing treatment train	The treatment system at the San Bernardino WWTP consists of screening, grit removal, primary clarification, secondary activated sludge (biological oxidation) with nitrification and denitrification, secondary clarification, and chlorination. Treatment at the regional tertiary facility is rapid infiltration and extraction (RIX), which consists of infiltration into a series of ponds, and extraction along with native groundwater for discharge.

A.4.2 Existing Permit Requirements

The following exhibit summarizes the existing permit requirements related to WET testing for the sample facility.

WET Permit Requirements: Colton/San Bernardino Regional Tertiary Treatment Facility

Permit issue date	9/30/2005
Permit expiration date	9/1/2010
Dilution	None
Acute monitoring	None
Acute limits	None
Chronic monitoring	Monthly; 1 species (*Ceriodaphnia dubia*); at least five dilutions (within 60% to 100% effluent concentration) and a control
Chronic limits	None
Accelerated monitoring trigger	Any single test > 1 TUc
TIE/TRE trigger	2-month median test value >1 TUc for survival or reproduction endpoint; any single test value >1.7 TUc for survival endpoint
Resume regular testing condition	2 consecutive data points result in 1.0 TUc, or when the results of the Initial Investigation Reduction Evaluation have adequately addressed the identified toxicity problem

A.4.3 Baseline Compliance

The following table summarizes WET data from 6/5/06 – 6/3/08.

Baseline Compliance, Chronic Toxicity: Colton/San Bernardino Regional Tertiary Treatment Facility

Species	*Ceriodaphnia dubia*
Test	Survival and reproduction
# of tests	27
# exceeding accelerated monitoring trigger	2
Exceeding TRE trigger? (Y/N)	Y

The discharger exceeded accelerated monitoring and TIE/TRE triggers over the period of the data.

A.4.4 Amendment Compliance

The discharger has RP under the Amendment because it is a major WWTP. The following table summarizes WET data from 6/5/06 – 6/3/08 under the Amendment.

Effluent Data Analysis under the Amendment, Chronic Toxicity: Colton/San Bernardino Regional Tertiary Treatment Facility

Species	*Ceriodaphnia dubia*
Test	Survival and reproduction
# of tests	27
# of potential exceedances of MDEL	1
Failure of MDEL verification test	No
# of potential exceedances of MMEL	1*
"fail" = statistically significant using the TST method *Uncertain because there were no additional tests in the same calendar month to determine compliance.	

Under the Amendment, the discharger will have to conduct three-species screening to determine the most sensitive species for chronic monitoring. Existing data is only available for *Ceriodaphnia dubia*. In addition, the existing data indicate that there is one exceedance of the MDEL, however the verification test indicates that accelerated monitoring would not be necessary for the exceedance because the test passed. If a toxicity test result is a "fail," but the percent effect is below the MDEL, dischargers must conduct two additional toxicity tests within the same calendar month in order to determine compliance with the MMEL. If either of these two additional tests results in a "fail," the median monthly result is "fail" and the discharger will be in exceedance of the MMEL. Because the data to assess compliance with the MMEL are not available, Abt Associates estimated potential compliance based on both potential outcomes: 1) monitoring indicates exceedance of the MMEL and 2) monitoring indicates compliance with the MMEL.

A.4.5 Potential Incremental Impact Summary

Under the scenario in which additional monitoring indicates that the facility is exceeding the MMEL, the compliance actions under the Amendment would be similar to those required under the existing permit. That is, the facility would need to conduct accelerated monitoring and a TRE. Thus, incremental costs would only reflect the additional monitoring associated with determining compliance with the MMEL, or approximately $400 per year.

Under the scenario in which additional monitoring indicates that the facility is in compliance with the MMEL, there could be a cost savings under the Amendment because there would no longer be a requirement to conduct accelerated monitoring and a TRE. Potential cost savings could be approximately $14,400 per year.

Potential Incremental Permit Limit Compliance Costs: Colton/San Bernardino Regional Tertiary Treatment Facility

Scenario	Potential to Exceed MDEL	Verification Test Costs	Total Incremental Costs			Incremental Annual Costs[2]
			MMEL Monitoring[1]	Accelerated Monitoring	TRE	
Comply with MMEL	No	$0	$1,200	-$4,500	-$40,000	-$14,400
Exceed MMEL	No	$0	$1,200	$0	$0	$400

1. Represents unit cost of $607 per test (average of 3 freshwater species tests) multiplied by 2 follow-up tests for MMEL monitoring trigger.
2. Total incremental costs divided by period of which data were evaluated (three years).

In addition, routine monitoring requirements would change under the Amendment in that chronic monitoring will be monthly with one species (most sensitive), but with a single-concentration test.

Routine Monitoring Costs: Colton/San Bernardino Regional Tertiary Treatment Facility

	Baseline	Amendment	Incremental
Frequency	12/yr	12/yr	NA
# Species	1	1	NA
Test type	Multiple dilutions	Single concentration	NA
Unit costs	$1,237 (*Ceriodaphnia dubia*)	$607 (Uncertain[1])	NA
Annual cost	$14,800	$7,300	-$7,600

NA = not applicable.
1. Sensitive species is uncertain because facility only has monitoring data for a single species; cost represents average of three freshwater species.

Incremental cost savings associated with routine monitoring would be approximately $7,600 per year.

There will also be an incremental cost associated with initial RP monitoring (chronic three-species testing) of approximately $6,200 (based on four samples per species and average single-concentration chronic test costs for freshwater vertebrates, invertebrates, and aquatic plants) at the beginning of each permit cycle, or $1,200 per year (assuming a 5-year permit cycle).

Thus, total incremental cost savings may range from approximately $20,800 to $6,000 per year.

Potential Total Annual Incremental Compliance Costs: Colton/San Bernardino Regional Tertiary Treatment Facility

Routine Monitoring	3-Species Sensitivity Monitoring	Permit Limit Compliance	Total Annual
-$7,600	$1,200	-$14,400 to $400	-$20,800 to -$6,000

A.5 Davis WWTP

The following sections document the incremental compliance analysis for the sample facility.

A.5.1 Facility Information

The following exhibit summarizes general information about the facility.

General Information: Davis WWTP

Name	Davis WWTP
NPDES No.	CA0079049
Category	Major municipal
Flow (mgd)	7.5
Receiving water	Willow Slough Bypass (Outfall 001) and Conaway Ranch Toe Drain (Outfall 002)
Existing treatment level	Secondary
Existing treatment train	The treatment system consists of a mechanical bar screen, an aerated grit tank, three primary sedimentation tanks, a primary anaerobic digester, a secondary anaerobic digester, three sludge lagoons, two aeration ponds (typically used in winter), three facultative oxidation ponds, a Lemna pond, an overland flow system, a chlorine contact tank, and restoration wetlands (used when discharging to Conaway Toe Drain). Biosolids are dewatered in on-site lagoons and the dried biosolids are land applied on-site in the overland flow fields.

A.5.2 Existing Permit Requirements

The following exhibit summarizes the existing permit requirements related to WET testing for the sample facility.

WET Permit Requirements: Davis WWTP

Permit issue date	10/25/2007
Permit expiration date	10/1/2012
Dilution	None
Acute monitoring	Monthly; 1 species (*Oncorhynchus mykiss*); 100% effluent
Acute limits	Survival of aquatic organisms in 96-hr bioassays of undiluted waste shall be no less than: 70%, minimum for any one bioassay; and 90%, median for any three consecutive bioassays.
Chronic monitoring	Quarterly; 3 species (*Ceriodaphnia dubia*, *Pimephales promelas*, *Selenastrum capricornutum*) control plus 5 dilutions (100%, 75%, 50%, 25%, 12.5%)
Chronic limits	None
Accelerated monitoring trigger	1 TUc (where TUc = 100/NOEC)
TRE trigger	1 TUc (where TUc = 100/NOEC)
Resume regular testing condition	If the results of 4 consecutive accelerated monitoring data points do not exceed the monitoring trigger, the Discharger may cease accelerated monitoring and resume regular chronic toxicity monitoring. However, notwithstanding the accelerated monitoring results, if there is adequate evidence of a pattern of effluent toxicity, the Executive Officer may require that the Discharger initiate a TRE.

A.5.3 Baseline Compliance

The following tables summarize WET data from 5/31/06 – 7/8/08 for Outfall 001 and Outfall 002.

Baseline Compliance, Acute Toxicity: Davis WWTP Outfall 001

Species	*Oncorhynchus mykiss*
Test	Survival
# of tests	7
# exceeding limit	0
# exceeding accelerated monitoring trigger	0
Exceeding TRE trigger? (Y/N)	N

Baseline Compliance, Acute Toxicity: Davis WWTP Outfall 002

Species	*Oncorhynchus mykiss*
Test	Survival
# of tests	7
# exceeding limit	0
# exceeding accelerated monitoring trigger	0
Exceeding TRE trigger? (Y/N)	N

Baseline Compliance, Chronic Toxicity: Davis WWTP Outfall 001

Ceriodaphnia dubia	
Test	Survival and reproduction
# of tests	7
# exceeding accelerated monitoring trigger	1
Exceeding TRE trigger? (Y/N)	Y
Pimephales promelas	
Test	Survival and growth
# of tests	7
# exceeding accelerated monitoring trigger	1
Exceeding TRE trigger? (Y/N)	Y
Selenastrum capricornutum	
Test	Growth
# of tests	7
# exceeding accelerated monitoring trigger	1
Exceeding TRE trigger? (Y/N)	Y

Baseline Compliance, Chronic Toxicity: Davis WWTP Outfall 002

Ceriodaphnia dubia	
Test	Survival and reproduction
# of tests	2
# exceeding accelerated monitoring trigger	1
Exceeding TRE trigger? (Y/N)	Y
Pimephales promelas	
Test	Survival and growth
# of tests	2
# exceeding accelerated monitoring trigger	0
Exceeding TRE trigger? (Y/N)	N

Baseline Compliance, Chronic Toxicity: Davis WWTP Outfall 002

Selenastrum capricornutum	
Test	Growth
# of tests	1
# exceeding accelerated monitoring trigger	1
Exceeding TRE trigger? (Y/N)	Y

The discharger exceeded both accelerated monitoring and TRE triggers for chronic toxicity at both outfalls over the period of the data.

A.5.4 Amendment Compliance

The discharger has RP under the Amendment because it is a major WWTP. The following tables summarize WET data from 5/31/06 – 7/8/08 under the Amendment for Outfall 001 and Outfall 002.

Effluent Data Analysis under the Amendment, Chronic Toxicity: Davis WWTP Outfall 001

Ceriodaphnia dubia	
Test	Survival and reproduction
# of tests	7
# of potential exceedances of MDEL	0
# of potential exceedances of MMEL	0
Pimephales promelas	
Test	Survival and growth
# of tests	7
# of potential exceedances of MDEL	0
# of potential exceedances of MMEL	0
Selenastrum capricornutum	
Test	Growth
# of tests	7
# of potential exceedances of MDEL	0
# of potential exceedances of MMEL	1*
"fail" = statistically significant using the TST method *Uncertain because there were no additional tests in the same calendar month to determine compliance.	

Effluent Data Analysis under the Amendment, Chronic Toxicity: Davis WWTP Outfall 002

Ceriodaphnia dubia	
Test	Survival and reproduction
# of tests	2
# of potential exceedances of MDEL	0
# of potential exceedances of MMEL	0
Pimephales promelas	
Test	Survival and growth
# of tests	2
# of potential exceedances of MDEL	0
# of potential exceedances of MMEL	0

Effluent Data Analysis under the Amendment, Chronic Toxicity: Davis WWTP Outfall 002

Selenastrum capricornutum	
Test	Growth
# of tests	1
# of potential exceedances of MDEL	0
# of potential exceedances of MMEL	1*
*Uncertain because there were no additional tests in the same calendar month to determine compliance.	

Based on the analysis of effluent data under the Amendment, *Selenastrum capricornutum* may be the most sensitive for Outfall 001 and Outfall 002. The analysis also indicates that there may be exceedances of the chronic MMEL for both outfalls because there is one "fail" result for each with a percent effect less than 50%. Under the Amendment additional monitoring to assess compliance with the MMEL (two additional samples in the same calendar month) would be needed. Because the data to assess compliance with the MMEL are not available, Abt Associates estimated potential compliance based on both potential outcomes: 1) monitoring indicates exceedance of the MMEL and 2) monitoring indicates compliance with the MMEL.

A.5.5 Potential Incremental Impact Summary

Under the scenario in which additional monitoring indicates that the facility is exceeding the MMEL, the compliance actions under the Amendment would be similar to those required under the existing permit. That is, the facility would need to conduct accelerated monitoring and a TRE. Thus, incremental costs would only reflect the additional monitoring associated with determining compliance with the MMEL, or approximately $400 per year.

Under the scenario in which additional monitoring indicates that the facility is in compliance with the MMEL, there could be a cost savings under the Amendment because there would no longer be a requirement to conduct accelerated monitoring and a TRE. Potential cost savings could be approximately $14,200 per year.

Potential Incremental Permit Limit Compliance Costs: Davis WWTP

Scenario	Exceed MDEL	Verification Test Costs	Total Incremental Costs			Incremental Annual Costs[2]
			MMEL Monitoring[1]	Accelerated Monitoring	TRE	
Comply with MMEL	No	$0	$1,100	-$3,700	-$40,000	-$14,200
Exceed MMEL	No	$0	$1,100	$0	$0	$400

1. Represents unit cost of $547 per test (for *Selenastrum capricornutum*) multiplied by 2 follow-up tests for exceedances of MMEL monitoring triggers at each outfall.
2. Total incremental costs divided by period of which data were evaluated (three years).

In addition, routine monitoring requirements would change under the Amendment in that Abt Associates assumed that permit writers would not require routine acute monitoring under the Amendment, as shown in the table below. Chronic monitoring will be monthly, but with one species (most sensitive) and single-concentration tests.

Routine Monitoring: Davis WWTP

Component	Baseline	Amendment	Incremental
Acute			
Frequency	12/yr (at 2 outfalls)	NA	NA
# Species	1	NA	NA
Test type	Single concentration	NA	NA
Unit cost	$387 (*Oncorhynchus mykiss*)	NA	NA
Annual cost	$9,300	NA	-$9,300
Chronic			
Frequency	4/yr (at 2 outfalls)	12/yr (at 2 outfalls)	NA
# Species	3	1	NA
Test type	Multiple dilutions	Single concentration	NA
Unit costs	$1,237 (*Ceriodaphnia dubia*) $1,225 (*Pimephales promelas*) $920 (*Selenastrum capricornutum*)	$547 (*Selenastrum capricornutum*[1])	NA
Annual cost	$27,100	$13,100	-$14,000
Total			
Annual cost	$36,400	$13,100	-$23,200

NA = not applicable.
Note: Detail may not add to total due to independent rounding.
1. Based on *Selenastrum capricornutum* as most sensitive species for both outfalls.

Incremental cost savings associated with routine monitoring would be approximately $23,200 per year.

There is no incremental cost associated with initial RP monitoring (chronic three-species testing) because the permit already requires such testing quarterly.

Thus, total incremental cost savings for the discharger may range from approximately $37,400 to $22,800 per year.

Potential Total Annual Incremental Compliance Costs: Davis WWTP

Routine Monitoring	3-Species Sensitivity Monitoring	Permit Limit Compliance	Total Annual
-$23,200	$0	-$14,200 to $400	-$37,400 to -$22,800

A.6 Dow Chemical Company, Pittsburg Plant

The following sections document the incremental compliance analysis for the sample facility.

A.6.1 Facility Information

The following exhibit summarizes general information about the facility.

General Information: Dow Chemical Company, Pittsburg Plant

Name	Dow Chemical Company, Pittsburg Plant
NPDES No.	CA0004910
Category	Major industrial (chemicals)
Flow (mgd)	0.5
Receiving water	Suisun Bay
Existing treatment level	Tertiary
Existing treatment train	Clarification, filtration, pH adjustment, and reverse osmosis

A.6.2 Existing Permit Requirements

The following exhibit summarizes the existing permit requirements related to WET testing for the sample facility.

WET Permit Requirements: Dow Chemical Company, Pittsburg Plant

Permit issue date	11/28/2001
Permit expiration date	10/31/2006
Dilution	10:1
Acute monitoring	Quarterly; 1 species (most sensitive)
Acute limits	The survival of organisms in undiluted effluent 11-sample median of not less than 90% survival, and 11-sample 90th percentile value not less than 70%.
Chronic monitoring	Quarterly; 1 species (*Thalassiosira pseudonana*); 100%, 75%, 50%, 25%, and 12.5% dilutions; rescreening for sensitive species each permit cycle
Chronic limits	None
Accelerated monitoring trigger	Monthly (accelerated) monitoring upon 3-sample median exceeding 10 TUc or single sample >= 20 TUc
TRE trigger	If accelerated monitoring confirms consistent toxicity above either "trigger", initiate TRE/TIE
Resume regular testing condition	Return to routine monitoring after appropriate elements of TRE Work Plan are implemented and either the toxicity drops below "trigger" levels, or, based on the results of the TRE, the Executive Officer authorizes a return to routine monitoring.

A.6.3 Baseline Compliance

The following tables summarize acute and chronic monitoring data for the facility from 7/25/06 to 4/21/08.

Baseline Compliance, Acute Toxicity: Dow Chemical Company, Pittsburg Plant

Pimephales promelas	
Test	Survival
# of tests	9
# exceeding limit	0
# exceeding accelerated monitoring trigger	0
Oncorhynchus mykiss	
Test	Survival
# of tests	8
# exceeding limit	0
# exceeding accelerated monitoring trigger	0
NA = not applicable.	

Baseline Compliance, Chronic Toxicity: Dow Chemical Company, Pittsburg Plant

Thalassiosira pseudonana	
Test	Growth
# of tests[1]	7
# exceeding accelerated monitoring trigger	0
Exceeding TRE trigger? (Y/N)	N
NA = not applicable. 1. One test result is for *Selenastrum capricornutum*.	

Evaluation of WET results indicates that the discharger is in compliance with the current permit over the period of data.

A.6.4 Amendment Compliance

Permit writers can allow dilution at their discretion. However, assuming that the facility would receive a dilution ratio of 10:1 as in the existing permit, the IWC would represent a 10% effluent sample.

The following table summarizes WET data from 7/28/06 to 1/24/08 under the Amendment based on comparison of 10% effluent sample to a control.

Analysis of Effluent Data under the Amendment, Chronic Toxicity: Dow Chemical, Pittsburg Plant

Thalassiosira pseudonana	
Test	Growth
# of tests[1]	7
# fails[2]	0
# with mean effect >10%	0
1. One test result is for *Selenastrum capricornutum*. 2. TST analysis based on b and α values for *Selenastrum capricornutum*. "fail" = statistically significant using the TST method	

The discharger would not have RP under the Amendment because there are no "fail" results and all of the results have a mean effect less than 10%.

A.6.5 Potential Incremental Impact Summary

The discharger is in compliance with baseline requirements and would not have RP under the Amendment. Thus, it is likely that incremental costs associated with permit limits would be zero.

Abt Associates assumed that permit writers would continue to require flow-through acute monitoring under the Amendment, as shown in the table below, and no routine chronic monitoring is needed because the discharger does not have RP under the Amendment. In addition, incremental cost savings associated with initial RP monitoring (chronic three species testing) would likely be minimal because the permit already requires at least three multiple dilution tests per species for permit renewal (the Amendment requires four single concentration tests per species).

Routine Monitoring Costs: Dow Chemical, Pittsburg Plant

Component	Baseline	Amendment	Incremental
Acute			
Frequency	4/yr	4/yr	NA
# Species	1	1	NA
Test type	Single concentration	Single concentration	NA
Unit cost	$370 (most sensitive[1])	$370 (most sensitive[1])	NA
Annual cost	$1,500	$1,500	$0
Chronic			
Frequency	4/yr	NA	NA
# Species	1	NA	NA
Test type	Multiple dilutions	NA	NA
Unit costs	$1,438 (*Thalassiosira pseudonana*)[2]	NA	NA
Annual cost	$5,800	NA	-$5,800
Total			
Annual cost	$7,300	$1,500	-$5,800

NA = not applicable.
1. Represents average of *Pimephales promelas* and *Oncorhynchus mykiss*.
2. No unit costs available for *Thalassiosira pseudonana*; cost represents unit costs for *Macrocystis pyrifera* (marine aquatic plant).

Thus, total incremental cost savings for the discharger under the Amendment may be approximately $5,800 per year.

Potential Total Annual Incremental Compliance Costs: Dow Chemical, Pittsburg Plant

Routine Monitoring	3-Species Sensitivity Monitoring	Permit Limit Compliance	Total Annual
-$5,800	$0	$0	-$5,800

A.7 California Department of Water Resources, Warne Power Plant

The following sections document the incremental compliance analysis for the sample facility.

A.7.1 Facility Information

The following exhibit summarizes general information about the facility.

General Information: California DWR, Warne Power Plant

Name	California Department of Water Resources, Warne Power Plant
NPDES No.	CA0059188
Category	Major industrial (other)
Flow (mgd)	1.752
Receiving water	Pyramid Lake (Outfalls 001 and 002)
Existing treatment level	Secondary
Existing treatment train	Chlorination, polymer flocculation, and filtration

A.7.2 Existing Permit Requirements

The following exhibit summarizes the existing permit requirements related to WET testing for the sample facility.

WET Permit Requirements: California DWR, Warne Power Plant

Permit issue date	7/3/2010
Permit expiration date	6/10/2015
Dilution	None
Acute monitoring	Annually; 1 species (*Pimephales promelas* for fresh water, *Atherinops affinis* for brackish water; *Menidia beryllina* optional if salinity 1 to 32 ppt); 100% effluent
Acute limits	Survival of aquatic organisms in 96-hr bioassays of undiluted waste shall be no less than: 70%, minimum for any one bioassay; and 90%, average for any three consecutive bioassays.
Chronic monitoring	Annually; vertebrate, invertebrate, plant initial test for 3 consecutive months; most sensitive species thereafter.
Chronic limits	>1.0 TUc
Accelerated monitoring trigger	Average survival in undiluted effluent of 3 consecutive 96-hr bioassay data points < 90% OR single test less than 70% survival (acute); Monthly median toxicity exceeds 1.0 TUc (chronic).
TIE/TRE trigger	If the initial test and any of the additional six acute toxicity bioassay data points result in less than 70% survival, including the initial test, OR if the results of any two of the six accelerated data points are less than 90% survival, the Discharger shall immediately begin a TIE. For chronic toxicity, if any three of the initial test plus the six follow-up tests exceeds 1 TUc, Discharger must begin a TRE.
Resume regular testing condition	If the additional data points indicate compliance with acute toxicity limitation, the Discharger may resume regular testing. Executive Officer may end accelerated schedule once TRE/TIE initiated if no longer needed.

A.7.3 Baseline Compliance

The following table summarizes acute WET data from 2/22/07 – 4/23/08. Chronic monitoring requirements and limits were added to the 2010 permit. Thus, due to a lack of more recent

effluent data, Abt Associates could not evaluate compliance with baseline chronic toxicity requirements.

Baseline Compliance, Acute Toxicity: California DWR, Warne Power Plant

Species	*Pimephales promelas*
Test	Survival
# of tests	14
# exceeding limit[2]	1
# exceeding accelerated monitoring trigger	1
Exceeding TRE trigger? (Y/N)[3]	N
1. It is uncertain which outfall(s) the data represent. 2. Average of 3 consecutive observations from 2/22/07 was 83% survival. 3. Accelerated monitoring data have survivals of greater than 95%.	

The discharger exceeded the limit and accelerated monitoring trigger over the period of the data.

A.7.4 Amendment Compliance

There are no chronic WET test data with which to evaluate potential compliance under the Amendment for this facility. Thus, it is uncertain whether the discharger would have RP or be in compliance with effluent limits under the Amendment.

A.7.5 Potential Incremental Impact Summary

Because there are no chronic data from which to assess compliance, Abt Associates assumed that the compliance actions under the Amendment would be the same as those under the baseline (i.e., accelerated monitoring).

Abt Associates assumed that permit writers would not require routine acute monitoring under the Amendment. In addition, if the discharger does not have RP, there will not be routing chronic monitoring. However, if the discharger has RP, chronic monitoring will be monthly, with one species (most sensitive) and single-concentration tests, as shown in the exhibit below.

Routine Monitoring: California DWR, Warne Power Plant

Component	Baseline	Amendment	Incremental
Acute			
Frequency	1/yr at 2 outfalls	NA	NA
# Species	1	NA	NA
Test type	Single concentration	NA	NA
Unit cost	$352 (*Pimephales promelas*)	NA	NA
Annual cost	$700	NA	-$700
Chronic			
Frequency	1/yr at 2 outfalls	12/yr at 2 outfalls	NA
# Species	1 (after determining most sensitive)	1	NA
Test type	Single concentration	Single concentration	NA
Unit costs	$607 (average of 3 species)	$607 (Uncertain[1])	NA
Annual cost	$1,200	$14,600	$13,300
Total			
Annual cost	$1,900	$14,600	$12,600
NA = not applicable. Note: detail may not add to total due to independent rounding. 1. The most sensitive species is uncertain; costs represent average across freshwater species.			

Incremental routine monitoring costs may be approximately $12,600 per year if the discharger has RP or a cost savings of $2,000 per year if the discharger does not have RP.

There is also no cost of initial RP monitoring because the permit already requires single-concentration chronic test costs for freshwater vertebrates, invertebrates, and aquatic plants for Outfalls 001 and 002 at the beginning of each permit cycle.

Thus, total incremental costs may range from a cost savings of approximately $2,000 per year if there is no RP to approximately $12,600 per year under a scenario of RP.

Potential Total Annual Incremental Compliance Costs: DWR, Warne Power Plant

Routine Monitoring	3-Species Sensitivity Monitoring	Permit Limit Compliance	Total Annual
-$2,000 to $12,600	$0	$0	-$2,000 to $12,600

A.8 LACSD San Jose Creek WRP

The following sections document the incremental compliance analysis for the sample facility.

A.8.1 Facility Information

The following exhibit summarizes general information about the facility.

General Information: LACSD San Jose Creek WRP

Name	LACSD San Jose Creek WWRP
NPDES No.	CA0053911
Category	Major municipal
Flow (mgd)	100 (62.5 mgd East Plant and 37.5 mgd West Plant)
Receiving water	San Gabriel River (Outfalls 001 and 003) and San Jose Creek (Outfall 002)
Existing treatment level	Tertiary
Existing treatment train	Facility consists of two treatment plants with separate sewer systems. Treatment trains for both plants are the same and consist of primary sedimentation, nitrification-denitrification activated sludge biological treatment, secondary sedimentation with coagulation, inert media filtration, chlorination and dechlorination. Sewage solids separated from the wastewater are returned to the trunk sewer for conveyance to Joint Water Pollution Control Plant for treatment and disposal.

A.8.2 Existing Permit Requirements

The following exhibit summarizes the existing permit requirements related to WET testing for the sample facility.

WET Permit Requirements: LACSD San Jose Creek WRP

Permit issue date	7/24/2009
Permit expiration date	5/10/2014
Dilution	None
Acute monitoring	Annually; 1 species (*Pimephales promelas* for fresh water discharges, *Atherinops affinis* for brackish discharges, and *Menidia beryllina* for brackish waters with salinity of 1 to 32 ppt)
Acute limits	Average survival in undiluted effluent for any 3 consecutive 96-hr static, static-renewal, or continuous flow bioassay data points of at least 90%, and no single test producing <70% survival.
Chronic monitoring	Monthly; 1 species with re-screening for most sensitive species every 24 months (*Ceriodaphnia dubia, Pimephales promelas*, *Selenastrum capricornutum*); 100% effluent and control
Chronic limits	1.0 TUc (where 1 TUc = 100/NOEC)
Accelerated monitoring trigger	Average survival in undiluted effluent of 3 consecutive 96-hr bioassay data points < 90% or single test <70% survival (acute) or monthly median chronic toxicity greater than 1.0 TUc.
TRE trigger	Any two of the six accelerated tests are less than 90% survival (acute, TIE); Any three out of the initial test and the six additional tests results exceed 1.0 TUc (chronic, TRE)
Resume regular testing condition	If the additional data points indicate compliance with acute toxicity limitation, the Discharger may resume regular testing.

A.8.3 Baseline Compliance

The following tables summarize WET data from 5/11/06 – 6/5/08 for each of the treatment plants.

Baseline Compliance, Acute Toxicity: LACSD San Jose Creek WRP East

Species	*Pimephales promelas*
Test	Survival
# of tests	2
# exceeding limit	0
# exceeding accelerated monitoring trigger	0
Exceeding TRE trigger? (Y/N)	N

Baseline Compliance, Acute Toxicity: LACSD San Jose Creek WRP West

Species	*Pimephales promelas*
Test	Survival
# of tests	2
# exceeding limit	0
# exceeding accelerated monitoring trigger	0
Exceeding TRE trigger? (Y/N)	N

Baseline Compliance, Chronic Toxicity: LACSD San Jose Creek WRP East

Ceriodaphnia dubia	
Test	Survival and reproduction
# of tests	2
# exceeding limit	0
# exceeding accelerated monitoring trigger	0
Exceeding TRE trigger? (Y/N)	N
Pimephales promelas	
Test	Survival and growth
# of tests	27
# exceeding limit	1
# exceeding accelerated monitoring trigger	1
Exceeding TRE trigger? (Y/N)	N
Selenastrum capricornutum	
Test	Growth
# of tests	2
# exceeding limit	0
# exceeding accelerated monitoring trigger	0
Exceeding TRE trigger? (Y/N)	N

Baseline Compliance, Chronic Toxicity: LACSD San Jose Creek WRP West

Ceriodaphnia dubia	
Test	Survival and reproduction
# of tests	4
# exceeding limit	1
# exceeding accelerated monitoring trigger	1
Exceeding TRE trigger? (Y/N)	N
Pimephales promelas	
Test	Survival and growth
# of tests	32
# exceeding limit	4
# exceeding accelerated monitoring trigger	4
Exceeding TRE trigger? (Y/N)	Y
Selenastrum capricornutum	
Test	Growth
# of tests	3
# exceeding limit	0
# exceeding accelerated monitoring trigger	0
Exceeding TRE trigger? (Y/N)	N

The discharger exceeded limits, accelerated monitoring triggers, and TRE triggers for chronic toxicity under the existing permit.

A.8.4 Amendment Compliance

The discharger has RP under the Amendment because it is a major WWTP. The following table summarizes WET data from 5/11/06 – 6/5/08 under the Amendment.

Effluent Data Analysis under the Amendment, Chronic Toxicity: LACSD San Jose Creek WRP East

Ceriodaphnia dubia	
Test	Survival and reproduction
# of tests	2
# of potential exceedances of MDEL	0
# of potential exceedances of MMEL	0
Pimephales promelas	
Test	Survival and growth
# of tests	27
# of potential exceedances of MDEL	0
# of potential exceedances of MMEL	0
Selenastrum capricornutum	
Test	Growth
# of tests	2
# of potential exceedances of MDEL	0
# of potential exceedances of MMEL	0
"fail" = statistically significant using the TST method	

Effluent Data Analysis under the Amendment, Chronic Toxicity: LACSD San Jose Creek WRP West

Ceriodaphnia dubia	
Test	Survival and reproduction
# of tests	4
# of potential exceedances of MDEL	1
Failure of verification test for MDEL	No
# of potential exceedances of MMEL	0
Pimephales promelas	
Test	Survival and growth
# of tests	32
# of potential exceedances of MDEL	0
# of potential exceedances of MMEL	0
Selenastrum capricornutum	
Test	Growth
# of tests	3
# of potential exceedances of MDEL	0
# of potential exceedances of MMEL	0

Based on the analysis of effluent data under the Amendment, *Ceriodaphnia dubia* may be the most sensitive species and would be used to assess compliance with the Amendment. The available data indicate that the discharger would not be in exceedance of either the MDEL or MMEL based on 100% effluent samples for the East and West plants.

A.8.5 Potential Incremental Impact Summary

Effluent data indicate that under the baseline the discharger would need to conduct accelerated monitoring at both treatment plants and a TRE at the West plant. However, under the Amendment, the discharger would likely be in compliance with projected effluent limits. Thus, there could be incremental cost savings under the Amendment of approximately $15,000 per year (-$4,900 for accelerated monitoring + -$40,000 for TRE ÷ 3 year period of data).

Potential Incremental Permit Limit Compliance Costs: LACSD San Jose Creek WRP

Scenario	Exceed MDEL	Verification Test Costs	Total Incremental Costs			Incremental Annual Costs[2]
			MMEL Monitoring[1]	Accelerated Monitoring	TRE	
Comply with Limits	No	$0	$0	-$4,900	-$40,000	-$15,000
1. Represents unit cost of $1,237 per test (for *Ceriodaphnia dubia*) multiplied by 4 tests. 2. Total incremental costs divided by period of which data were evaluated (three years).						

Abt Associates assumed that permit writers would not require routine acute monitoring under the Amendment, as shown in the table below. Chronic monitoring will be monthly, but with one species (most sensitive) and single-concentration tests. In addition, there is no incremental cost associated with initial RP monitoring (chronic three-species testing) because the permit already requires such testing biannually.

Routine Monitoring: LACSD San Jose Creek WRP

Component	Baseline	Amendment	Incremental
Acute			
Frequency	1/yr at 3 outfalls	NA	NA
# Species	1	NA	NA
Test type	Single concentration	NA	NA
Unit cost	$352 (*Pimephales promelas*)	NA	NA
Annual cost	$1,100	NA	-$1,100
Chronic			
Frequency	12/yr for most sensitive species; 3 samples every 2 years for other 2 species; for 3 outfalls	12/yr at 3 outfalls	NA
# Species	Varies	1	NA
Test type	Single concentration	Single concentration	NA
Unit costs	$674 (*Ceriodaphnia dubia*) $600 (*Pimephales promelas*) $547 (*Selenastrum capricornutum*)	$674 (*Ceriodaphnia dubia*)	NA
Annual cost	$27,100	$24,200	-$2,800
Total			
Annual cost	$28,200	$24,200	-$3,900
NA = not applicable.			

Incremental cost savings associated with routine monitoring would be approximately $3,900 per year.

Thus, total incremental cost savings may be approximately $18,900 per year.

Potential Total Annual Incremental Compliance Costs: LACSD San Jose Creek WRP

Routine Monitoring	3-Species Sensitivity Monitoring	Permit Limit Compliance	Total Annual
-$3,900	$0	-$15,000	-$18,900

A.9 Lompoc Regional WWTP

The following sections document the incremental compliance analysis for the sample facility.

A.9.1 Facility Information

The following exhibit summarizes general information about the facility.

General Information: Lompoc Regional WWTP

Name	Lompoc Regional WWTP
NPDES No.	CA0048127
Category	Major municipal
Flow (mgd)	5
Receiving water	Santa Miguelito Creek
Existing treatment level	Secondary
Existing treatment train	Mechanical bar screens, primary clarifiers, biotower, aeration tank, secondary clarifiers, and a chlorine contact tank.

A.9.2 Existing Permit Requirements

The following exhibit summarizes the existing permit requirements related to WET testing for the sample facility.

WET Permit Requirements: Lompoc Regional WWTP

Permit issue date	1/13/2012
Permit expiration date	1/13/2017
Dilution	None
Acute monitoring	Monthly; 1 species (*Pimephales promelas*); 100% effluent
Acute limits	No differential mortality between 100% effluent and controls.
Chronic monitoring	Quarterly; 3 species screening (*Ceriodaphnia dubia*, *Pimephales promelas*, *Selenastrum capricornutum*), after which may be reduced to most sensitive; dilutions of 100%, 85%, 70%, 50%, and 25%
Chronic limits	1.0 TUc
Accelerated monitoring trigger	Statistically different at 95% confidence (acute) or chronic toxicity in effluent > 1.0 TUc
TRE/TIE trigger	If 2 of three accelerated toxicity tests are failed, perform TIE
Resume regular testing condition	If accelerated monitoring indicates that toxicity triggers are not exceeded, return to regular monitoring.

A.9.3 Baseline Compliance

The following tables summarize WET data from 6/7/06 – 9/13/08.

Baseline Compliance, Acute Toxicity: Lompoc Regional WWTP

Pimephales promelas	
Test	Survival
# of tests	24
# exceeding limit	1
# exceeding accelerated monitoring trigger	1
Exceeding TRE trigger? (Y/N)	N
Ceriodaphnia dubia	
Test	Survival
# of tests	3
# exceeding limit	0
# exceeding accelerated monitoring trigger	0
Exceeding TRE trigger? (Y/N)	N

Baseline Compliance, Chronic Toxicity: Lompoc Regional WWTP

Ceriodaphnia dubia	
Test	Survival and reproduction
# of tests[1]	1
# exceeding limit	0
# exceeding accelerated monitoring trigger	0
Exceeding TRE trigger? (Y/N)	N
Pimephales promelas	
Test	Survival and growth
# of tests	1
# exceeding limit	0
# exceeding accelerated monitoring trigger	0
Exceeding TRE trigger? (Y/N)	N
Selenastrum capricornutum	
Test	Growth
# of tests	11
# exceeding limit	11
# exceeding accelerated monitoring trigger	11
Exceeding TRE trigger? (Y/N)	Y

The discharger is out of compliance for chronic toxicity under the existing permit over the period of the data.

A.9.4 Amendment Compliance

The discharger has RP under the Amendment because it is a major WWTP. The following table summarizes WET data from 6/7/06 – 9/13/08 under the Amendment.

Potential Amendment Compliance, Chronic Toxicity: Lompoc Regional WWTP

Ceriodaphnia dubia	
Test	Survival and reproduction
# of tests	1
# of potential exceedances of MDEL	0
# of potential exceedances of MMEL	0
Pimephales promelas	
Test	Survival and growth
# of tests	1
# of potential exceedances of MDEL	0
# of potential exceedances of MMEL	0
Selenastrum capricornutum	
Test	Growth
# of tests	11
# of potential exceedances of MDEL	5
Failure of verification tests	Not available
# of potential exceedances of MMEL	5*
"fail" = statistically significant using the TST method *Uncertain because there were no additional tests in the same calendar month to determine compliance.	

Based on the analysis of effluent data under the Amendment, *Selenastrum capricornutum* is the most sensitive species and would be used to assess compliance with the projected effluent limit. The data indicate that the discharger is exceeding both the chronic MDEL and MMEL based on 100% effluent sample.

A.9.5 Potential Incremental Impact Summary

Given exceedances of both the MDEL and MMEL under the Amendment, the facility would likely need accelerated monitoring and a TRE. However, given the *Selenastrum capricornutum* results, the discharger would likely need to conduct accelerated monitoring and a TRE under the baseline as well. Thus, incremental controls costs are likely zero.

Abt Associates assumed that permit writers would not require routine acute monitoring under the Amendment. Chronic monitoring will be monthly, but with single-concentration tests. In addition, incremental cost savings associated with initial RP monitoring (chronic three species testing) would likely be minimal because the permit already requires at least three multiple dilution tests per species (the Amendment requires four single concentration tests per species).

Routine Monitoring: Lompoc Regional WWTP

Component	Baseline	Amendment	Incremental
Acute			
Frequency	12/yr	NA	NA
# Species	1	NA	NA
Test type	Single concentration	NA	NA
Unit cost	$352 (*Pimephales promelas*)	NA	NA
Annual cost	$4,200	NA	-$4,200
Chronic			
Frequency	4/yr for most sensitive species; 2 additional species for 1st quarter	12/yr	NA
# Species	Varies (*Selenastrum capricornutum* most sensitive)	1	NA
Test type	Multiple dilutions	Single concentration	NA
Unit costs	$1,237 (*Ceriodaphnia dubia*) $1,225 (*Pimephales promelas*) $920 (*Selenastrum capricornutum*)	$547 (*Selenastrum capricornutum*)	NA
Annual cost	$4,200	$6,600	$2,400
Total			
Annual cost	$8,400	$6,600	-$1,800
NA = not applicable.			

Thus, total incremental cost savings for the discharger may be $1,800 per year.

Potential Total Annual Incremental Compliance Costs: Lompoc Regional WWTP

Routine Monitoring	3-Species Sensitivity Monitoring	Permit Limit Compliance	Total Annual
-$1,800	$0	$0	-$1,800

A.10 Pactiv Corporation

The following sections document the incremental compliance analysis for the sample facility.

A.10.1 Facility Information

The following exhibit summarizes general information about the facility.

General Information: Pactiv Corporation

Name	Pactiv Corporation Molded Pulp Mill, Tehama County
NPDES No.	CA0004821
Category	Major industrial (pulp and paper)
Flow (mgd)	2.7
Receiving water	Lake Red Bluff, Sacramento River
Existing treatment level	Secondary
Existing treatment train	Primary settling, clarification and aeration

A.10.2 Existing Permit Requirements

The following exhibit summarizes the existing permit requirements related to WET testing for the sample facility.

WET Permit Requirements: Pactiv Corporation

Permit issue date	6/10/2011
Permit expiration date	6/1/2016
Dilution	None
Acute monitoring	Twice per month; 1 species (*Oncorhynchus mykiss*)
Acute limits	Survival of aquatic organisms in 96-hour bioassays of undiluted waste shall be no less than 70% for one bioassay, and the median for any three or more consecutive bioassays shall be no less than 90%.
Chronic monitoring	Annually; 3 species (*Pimephales promelas*, *Ceriodaphnia dubia*, and *Selenastrum capricornutum*); 12.5% 6.25% and 3.125% dilutions.
Chronic limits	None
Accelerated monitoring trigger	If a sample exhibits toxicity of > 1 TUc, the Discharger shall perform four chronic toxicity tests in a six week period using species that exhibited toxicity.
TIE/TRE trigger	If a pattern of toxicity is demonstrated, specifically if any of the four chronic toxicity tests subsequent to the initial failure demonstrates toxicity, a TRE is required. Executive Officer may also require a TRE if other evidence indicates toxicity occurs >20% of the time. A TIE may be required if appropriate.
Resume regular testing condition	If source of toxicity is readily identified, four consecutive accelerated tests that do not exceed the monitoring trigger will be considered sufficient to assume regular monitoring

A.10.3 Baseline Compliance

The following tables summarize WET data from 8/8/06 – 8/14/07.

Baseline Compliance, Acute Toxicity: Pactiv Corporation

Species	*Oncorhynchus mykiss*
Test	Survival and reproduction
# of tests	32
# exceeding limits	0

Baseline Compliance, Chronic Toxicity: Pactiv Corporation

Ceriodaphnia dubia	
Test	Survival and reproduction
# of tests	2
# exceeding accelerated monitoring trigger	2
Exceeding TRE trigger? (Y/N)	No data to evaluate
Pimephales promelas	
Test	Survival and growth
# of tests	3
# exceeding accelerated monitoring trigger	3
Exceeding TRE trigger? (Y/N)	No data to evaluate
Selenastrum capricornutum	
Test	Growth
# of tests	2
# exceeding accelerated monitoring trigger	2
Exceeding TRE trigger? (Y/N)	No data to evaluate

The discharger exceeded the accelerated monitoring trigger for chronic toxicity for all species over the period of the data. In addition, although there are no accelerated monitoring data from which to determine whether a TRE would be needed under the existing permit, given that all observations exceed the chronic monitoring trigger, it is likely that a TRE would be needed under baseline requirements.

A.10.4 Amendment Compliance

The previous permit (2006) allowed an 8:1 dilution ration, which represents and IWC of 12.5% effluent. However, the 2011 permit does not allow for dilution, resulting in an IWC representing a 100% effluent sample. Due to a lack of more recent data, Abt Associates evaluated compliance with the Amendment based on the highest percent effluent data available, 50%.

The following table summarizes WET data from 8/8/06 – 8/14/07 under the Amendment based on comparison of 50% effluent sample to a control.

Analysis of Effluent Data under the Amendment, Chronic Toxicity: Pactiv Corporation

Ceriodaphnia dubia	
Test	Survival and reproduction
# of tests	2
# of fails	0
# with mean effect >10%	0
Pimephales promelas	
Test	Survival and growth
# of tests	3
# of fails	1
# with mean effect >10%	2
# of potential exceedances of MDEL	0
# of potential exceedances of MMEL	1*
Selenastrum capricornutum	
Test	Growth
# of tests	2
# of fails	0
# with mean effect >10%	0
"fail" = statistically significant using the TST method *Uncertain because there were no additional tests in the same calendar month to determine compliance.	

Based on the analysis of effluent data under the Amendment, the discharger would have RP because two of the test results for *Pimephales promelas* have a mean effect above 10%.

The single "fail" result with percent effect below 50% would trigger monitoring to assess compliance with the MMEL. However, the data to assess compliance with the MMEL are not available. Given that the analysis reflects a dilution ratio of 2:1 (50% effluent samples) and the facility does not currently receive dilution in its existing permit, Abt Associates estimated potential compliance based on the assumption that accelerated monitoring indicates exceedance of the MMEL.

A.10.5 Potential Incremental Impact Summary

Under the scenario in which additional monitoring indicates that the facility is exceeding the MMEL, compliance actions under the baseline are likely the same as those under the Amendment (i.e., accelerated monitoring and a TRE). Thus, incremental costs would be zero.

In addition, routing monitoring requirements would change in that Abt Associates assumed that permit writers would not require routine acute monitoring under the Amendment, as shown in the table below. Chronic monitoring will be monthly, but with one species (most sensitive) and single-concentration tests.

Routine Monitoring: Pactiv Corporation

Component	Baseline	Amendment	Incremental
Acute			
Frequency	24/yr	NA	NA
# Species	1	NA	NA
Test type	Single concentration	NA	NA
Unit cost	$387 (*Oncorhynchus mykiss*)	NA	NA
Annual cost	$9,300	NA	-$9,300
Chronic			
Frequency	1/yr	12/yr	NA
# Species	3	1	NA
Test type	Multiple dilutions	Single concentration	NA
Unit costs	$1,237 (*Ceriodaphnia dubia*) $1,225 (*Pimephales promelas*) $920 (*Selenastrum capricornutum*)	$600 (*Pimephales promelas*)	NA
Annual cost	$3,400	$7,200	$3,800
Total			
Annual cost	$12,700	$7,200	-$5,500
NA = not applicable.			

Total incremental cost savings associated with routine monitoring for the discharger may be approximately $5,500.

There is also no incremental cost associated with initial RP monitoring (chronic three-species testing) because the permit already requires three-species testing annually.

Thus, total incremental cost savings may be approximately $5,500 per year.

Potential Total Annual Incremental Compliance Costs: Pactiv Corporation

Routine Monitoring	3-Species Sensitivity Monitoring	Permit Limit Compliance	Total Annual
-$5,500	$0	$0	-$5,500

A.11 Sacramento Regional WWTP

The following sections document the incremental compliance analysis for the sample facility.

A.11.1 Facility Information

The following exhibit summarizes general information about the facility.

General Information: Sacramento Regional WWTP

Name	Sacramento Regional WWTP
NPDES No.	CA0077682
Category	Major municipal
Flow (mgd)	181
Receiving water	Sacramento River
Existing treatment level	Secondary
Existing treatment train	Treatment operation consists of coarse screening, aerated grit chambers, primary sedimentation, pure oxygen activated sludge, secondary clarification, and disinfection using chlorination/dechlorination systems.

A.11.2 Existing Permit Requirements

The following exhibit summarizes the existing permit requirements related to WET testing for the sample facility.

Permit Requirements: Sacramento Regional WWTP

Permit issue date	12/1/2010
Permit expiration date	12/1/2015
Dilution	None
Acute monitoring	Weekly; 1 species (*Oncorhynchus mykiss, as of July 1, 2011*)
Acute limits	Survival of aquatic organisms in 96-hour bioassays of undiluted waste of no less than 70%, minimum for any one bioassay; and 90%, median for any 3 consecutive bioassays.
Chronic monitoring	Monthly; 3 species (*Pimephales promelas*, *Ceriodaphnia dubia*, *Selenastrum capricornutum*); standard 5 dilution series (ranging from 100 to 6.25% sample)
Chronic limits	None
Accelerated monitoring trigger	TUc >= 8
TRE trigger	Follow-up chronic test within 9 days >= 8 TU
Resume regular testing condition	If the follow up sample demonstrates an NOEC of < 8 TUs, the Discharger shall conduct 2 additional weekly chronic tests from the same sample location on the affected test species to check for persistent toxicity. If there is no further significant toxicity shown on the follow up samples, the accelerated monitoring can be discontinued and event monitoring will resort to the regular schedule.

A.11.3 Baseline Compliance

The following tables summarize WET data from 1/2/06 to 7/21/08. Note that the 2010 permit changed the acute species from *Pimephales promelas* to *Oncorhynchus mykiss* as of July 2011. Thus, due to a lack of more recent effluent data, the analysis below is based on *Pimephales promelas* for acute toxicity.

Baseline Compliance, Acute Toxicity: Sacramento Regional WWTP

Species	*Pimephales promelas*
Test	Survival
# of tests	134
# exceeding limit	7

Baseline Compliance, Chronic Toxicity: Sacramento Regional WWTP

Ceriodaphnia dubia	
Test	Survival and reproduction
# of tests	10
# exceeding accelerated monitoring trigger	4
Exceeding TRE trigger? (Y/N)	Y
Pimephales promelas	
Test	Survival and growth
# of tests	10
# exceeding accelerated monitoring trigger	1
Exceeding TRE trigger? (Y/N)	N
Selenastrum capricornutum	
Test	Growth
# of tests	12
# exceeding accelerated monitoring trigger	0
Exceeding TRE trigger? (Y/N)	N

The discharger exceeded limits and both accelerated monitoring and TRE triggers for acute and chronic toxicity over the period of the data.

A.11.4 Amendment Analysis

The discharger has RP under the Amendment because it is a major WWTP. The following table summarizes WET data from 1/2/06 to 7/21/08 under the Amendment.

Effluent Data Analysis under the Amendment, Chronic Toxicity: Sacramento Regional WWTP

Ceriodaphnia dubia	
Test	Survival and reproduction
# of tests	13
# of potential exceedances of MDEL	13
Failure of verification tests	Yes
Pimephales promelas	
Test	Survival and growth
# of tests	10
# of potential exceedances of MDEL	2
Failure of verification tests	Not available
# of potential exceedances of MMEL	4*

Effluent Data Analysis under the Amendment, Chronic Toxicity: Sacramento Regional WWTP

Selenastrum capricornutum	
Test	Growth
# of tests	12
# of potential exceedances of MDEL	0
# of potential exceedances of MMEL	1*
"fail" = statistically significant using the TST method *Uncertain because there were no additional tests in the same calendar month to determine compliance.	

Based on the analysis of effluent data under the Amendment, *Ceriodaphnia dubia* is the most sensitive species and would be used to assess compliance with the projected effluent limit. All of the test results exceed the projected chronic MDEL based on 100% effluent sample.

A.11.5 Potential Incremental Impact Summary

Given the number of exceedances under the Amendment, the facility would likely need to conduct accelerated monitoring and a TRE. However, as a result of baseline toxicity, the facility has been conducting a TRE since April 2004 (SRCSD, 2008). Thus, incremental controls costs are likely zero.

However, Abt Associates assumed that permit writers would not require routine acute monitoring under the Amendment, as shown in the table below. Chronic monitoring will be monthly, but with one species (most sensitive) and single-concentration tests. In addition, there is no incremental cost associated with initial RP monitoring (chronic three-species testing) because the permit already requires such testing quarterly.

Routine Monitoring: Sacramento Regional WWTP

Component	Baseline	Amendment	Incremental
Acute			
Frequency	52/yr	NA	NA
# Species	1	NA	NA
Test type	Single concentration	NA	NA
Unit cost	$387 (*Oncorhynchus mykiss*)	NA	NA
Annual cost	$20,100	NA	-$20,100
Chronic			
Frequency	12/yr	12/yr	NA
# Species	3	1	NA
Test type	Multiple dilutions	Single concentration	NA
Unit costs	$1,237 (*Ceriodaphnia dubia*) $1,225 (*Pimephales promelas*) $920 (*Selenastrum capricornutum*)	$674 (*Ceriodaphnia dubia*)	NA
Annual cost	$40,600	$8,100	-$32,500
Total			
Annual cost	$60,700	$8,100	-$52,600
NA = not applicable. Note, details may not add to total due to independent rounding.			

Thus, total incremental cost savings for the discharger may be $52,600 per year.

Potential Total Annual Incremental Compliance Costs: Sacramento Regional WWTP

Routine Monitoring	3-Species Sensitivity Monitoring	Permit Limit Compliance	Total Annual
-$52,600	$0	$0	-$52,600

A.12 Shell Oil, Martinez Refinery

The following sections document the incremental compliance analysis for the sample facility.

A.12.1 Facility Information

The following exhibit summarizes general information about the facility.

General Information: Shell Oil, Martinez Refinery

Name	Shell Oil, Martinez Refinery
NPDES No.	CA0005789
Category	Major industrial (petroleum refining)
Flow (mgd)	6.7
Receiving water	Carquinez Strait
Existing treatment level	Tertiary
Existing treatment train	The treatment system consists of 3 oil-water separators, 4 dissolved nitrogen flotation units, a number of equalization and diversion tanks, 2 activated sludge biological treatment systems, a number of ponds, a chemical precipitation unit for the removal of selenium, and a GAC adsorption system for polishing treated wastewater.

A.12.2 Existing Permit Requirements

The following exhibit summarizes the existing permit requirements related to WET testing for the sample facility.

WET Permit Requirements: Shell Oil, Martinez Refinery

Permit issue date	10/11/2006
Permit expiration date	10/31/2011
Dilution	10:1
Acute monitoring	Weekly; 1 species (*Oncorhynchus mykiss*)
Acute limits	The survival of organisms in undiluted effluent 11-sample median value of not less than 90%, and 11-sample 90th percentile value of not less than 70%.
Chronic monitoring	Quarterly; 1 species (*Americamysis bahia*); 100%, 50%, 25%, 10%, and 5%, and 2.5% dilutions; 3-species screening for sensitive species at permit reissuance.
Chronic limits	A single-sample value of <= 10 TUc
Accelerated monitoring trigger	A single-sample value > 10 TUc. Accelerated monitoring shall consist of monthly monitoring.
TRE trigger	If accelerated monitoring data points continue to exceed the evaluation parameter, then the Discharger shall initiate a chronic TRE.
Resume regular testing condition	If data from accelerated monitoring data points are found to be in compliance with the evaluation parameter, then regular monitoring shall be resumed.

A.12.3 Baseline Compliance

The following tables summarize WET data from 5/6/06 to 5/31/08 under the existing permit.

Baseline Compliance, Acute Toxicity: Shell Oil, Martinez Refinery

Species	*Oncorhynchus mykiss*
Test	Survival
# of tests	109
# exceeding limit	0
# exceeding accelerated monitoring trigger	0

Baseline Compliance, Chronic Toxicity: Shell Oil, Martinez Refinery

Species	*Americamysis bahia*
Test	Growth and Survival
# of tests	9
# exceeding limit	0
# exceeding accelerated monitoring trigger	0
Exceeding TRE trigger? (Y/N)	N

The discharger is in compliance under the existing permit for the period of data.

A.12.4 Amendment Compliance

Permit writers can allow dilution at their discretion. However, assuming that the facility would receive a dilution ratio of 10:1 as in the existing permit, the IWC would represent a 10% effluent sample.

The following table summarizes WET data from 5/6/06 to 5/31/08 under the Amendment based on comparison of 10% effluent sample to a control.

Analysis of Effluent Data under the Amendment, Chronic Toxicity: Shell Oil, Martinez Refinery

Species	Americamysis bahia
Test	Growth and Survival
# of tests	9
# of fails	1
# with mean effect >10%	2
# of potential exceedances of MDEL	0
# of potential exceedances of MMEL	1*
"fail" = statistically significant using the TST method *Uncertain because there were no additional tests in the same calendar month to determine compliance	

The permit indicates that *Americamysis bahia* is the most sensitive species. Based on these data, the discharger would have RP under the Amendment because two samples have a mean effect greater than 10%.

Compliance with the projected chronic limits is based on 10% effluent sample. The monitoring data in the table indicate that the one "fail" result with percent effect below 50% would result in the need for additional monitoring to assess compliance with the MMEL. Because the data to assess compliance with the MMEL are not available, Abt Associates estimated potential compliance based on both potential outcomes: 1) monitoring indicates exceedance of the MMEL and 2) monitoring indicates compliance with the MMEL.

A.12.5 Potential Incremental Impact Summary

Under the scenario in which additional monitoring indicates that the facility is exceeding the MMEL under the Amendment, the discharger could incur incremental costs associated with accelerated monitoring and a TRE (the discharger is in compliance with baseline limits). Thus, incremental costs could be approximately $15,700 per year (as shown in the table below).

Under the scenario in which additional monitoring indicates that the facility is in compliance with the MMEL, incremental costs reflect the cost of additional monitoring of $300 per year.

Potential Incremental Permit Limit Compliance Costs: Shell Oil, Martinez Refinery

Scenario	Exceed MDEL	Verification Test Costs	Total Incremental Costs			Incremental Annual Costs[2]
			MMEL Monitoring[1]	Accelerated Monitoring	TRE	
Comply with MMEL	No	$0	$1,000	$0	$0	$300
Exceed MMEL	No	$0	$1,000	$6,200	$40,000	$15,700

1. Represents unit cost of $500 per test (*Holmesimysis costata*) for follow-up tests.
2. Total incremental costs divided by period of data evaluated (three years).

In addition, Abt Associates assumed that permit writers would continue to require routine flow-through acute monitoring, as shown in the table below. Chronic monitoring will be monthly, but with single-concentration tests.

Routine Monitoring: Shell Oil, Martinez Refinery

Component	Baseline	Amendment	Incremental
Acute			
Frequency	52/yr	52/yr	NA
# Species	1	1	NA
Test type	Single concentration	Single concentration	NA
Unit cost	$387 (*Oncorhynchus mykiss*)	$387 (*Oncorhynchus mykiss*)	NA
Annual cost	$20,100	$20,100	$0
Chronic			
Frequency	4/yr	12/yr	NA
# Species	1	1	NA
Test type	Multiple dilutions	Single concentration	NA
Unit costs	$1,550 (*Americamysis bahia*)[1]	$500 (*Americamysis bahia*[1,2])	NA
Annual cost	$6,200	$6,000	-$200
Total			
Annual cost	$26,300	$26,100	-$200

NA = not applicable.
1. EPA WET test methods for *Americamysis bahia* and *Holmesimysis costata* are the same; costs represent WET test for *Holmesimysis costata* survival and growth.
2. Assumed most sensitive species per existing permit.

Total incremental cost savings associated with routine monitoring for the discharger may be $200.

Also, incremental cost savings associated with initial RP monitoring (chronic three species testing) would likely be minimal because the permit already requires at least three multiple dilution tests per species prior to permit reissuance (the Amendment requires four single concentration tests per species).

Thus, total incremental costs may range from approximately $100 to $15,500 per year.

Potential Total Annual Incremental Compliance Costs: Shell Oil, Martinez Refinery

Routine Monitoring	3-Species Sensitivity Monitoring	Permit Limit Compliance	Total Annual
-$200	$0	$300 to $15,700	$100 to $15,500

A.13 USS-POSCO Industries

The following sections document the incremental compliance analysis for the sample facility.

A.13.1 Facility Information

The following exhibit summarizes general information about the facility.

General Information: USS-POSCO Industries

Name	USS-POSCO Industries
NPDES No.	CA0005002
Category	Major industrial (metals)
Flow (mgd)	20
Receiving water	Suisun Bay
Existing treatment level	Secondary
Existing treatment train	Oil separation, flocculation, clarification, and final pH adjustment

A.13.2 Existing Permit Requirements

The following exhibit summarizes the existing permit requirements related to WET testing for the sample facility.

WET Permit Requirements: USS-POSCO Industries

Permit issue date	9/1/2011
Permit expiration date	8/31/2016
Dilution	4:1
Acute monitoring	Biweekly; 1 species (*Oncorhynchus mykiss*); 96 hour continuous flow-through bioassay using dechlorinated effluent
Acute limits	The survival of organisms in undiluted effluent shall be an 11-sample median value of not less than 90% survival, and an 11-sample 90 percentile value of not less than 70% survival.
Chronic monitoring	Quarterly; 1 species (*Haliotis rufescens*); multiple concentrations; screening for most sensitive species at permit reissuance
Chronic limits	A three-sample median value of equal to or less than 5 TUc; and a single-sample maximum value of equal to or less than 10 TUc.
Accelerated monitoring trigger	Single-test value greater than 8 TUc or three-sample median of 4 TUc. Accelerated monitoring is monthly.
TRE trigger	If accelerated monitoring data points continue to exceed chronic toxicity limitation(s) then the discharger shall initiate a chronic toxicity reduction evaluation and continue accelerated monitoring.
Resume regular testing condition	If data from accelerated monitoring data points are found to be in compliance with the chronic toxicity effluent limitations, then regular monitoring shall be resumed.

A.13.3 Baseline Compliance

The following tables summarize WET data from 3/1/06 to 5/28/08.

Baseline Compliance, Acute Toxicity: USS-POSCO Industries

Species	*Oncorhynchus mykiss*
Test	Survival
# of tests	58
# exceeding limit	5

Baseline Compliance, Chronic Toxicity: USS-POSCO Industries

Species	*Haliotis rufescens*
Test	Larval development
# of tests	8
# exceeding limit	2
# exceeding accelerated monitoring trigger	2
Exceeding TRE trigger? (Y/N)	N

The discharger has exceeded acute and chronic limits over the period of data.

A.13.4 Amendment Compliance

Permit writers can allow dilution at their discretion. However, assuming that the facility would receive a dilution ratio of 4:1 as in the existing permit, the IWC would represent a 25% effluent sample.

The following table summarizes WET data from 3/1/06 to 5/28/08 under the Amendment. The analysis is based on comparison of 25% effluent sample to a control.

Analysis of Effluent Data under the Amendment, Chronic Toxicity: USS-POSCO Industries

Species	*Haliotis rufescens*
Test	Larval development
# of tests	8
# of fails	1
# with mean effect >10%	2
# of potential exceedances of MDEL	0
# of potential exceedances of MMEL	1*
"fail" = statistically significant using the TST method *Uncertain because there are no additional tests in the same calendar month to determine compliance	

Based on the 25% effluent sample the discharger would have RP because 2 test results have mean effects greater than 10%. The single "fail" result with a percent effect below 50% would trigger monitoring to assess compliance with the MMEL. Because the data to assess compliance with the MMEL are not available, Abt Associates estimated potential compliance based on both potential outcomes: 1) monitoring indicates exceedance of the MMEL and 2) monitoring indicates compliance with the MMEL.

A.13.5 Potential Incremental Impact Summary

Under the scenario in which additional monitoring indicates that the facility is exceeding the MMEL, the facility may need to conduct accelerated monitoring and a TRE; under baseline requirements the facility only exceeded the accelerated monitoring trigger (and not the TRE

trigger). Thus, incremental costs would reflect the additional monitoring associated with determining compliance with the MMEL and the potential for a TRE, or approximately $13,900 per year.

Under the scenario in which additional monitoring indicates that the facility is in compliance with the MMEL, there could be a cost savings under the Amendment because there would no longer be a requirement to conduct accelerated monitoring. Potential cost savings could be approximately $1,400 per year.

Potential Incremental Permit Limit Compliance Costs: USS-POSCO Industries

Scenario	Exceed MDEL	Verification Test Costs	Total Incremental Costs			Incremental Annual Costs[2]
			MMEL Monitoring[1]	Accelerated Monitoring	TRE	
Comply with MMEL	No	$0	$1,700	-$6,000	$0	-$1,400
Exceed MMEL	No	$0	$1,700	$0	$40,000	$13,900

1. Represents unit cost of $845 per test (*Haliotis rufescens*) multiplied by 2 follow-up tests for the exceedance of the MMEL monitoring trigger.
2. Total incremental costs divided by period of which data were evaluated (3 years).

In addition, Abt Associates assumed that permit writers would continue to require routine flow-through acute monitoring under the Amendment, as shown in the table below. Chronic monitoring will be monthly if there is RP.

Routine Monitoring: USS-POSCO Industries

Component	Baseline	Amendment	Incremental
Acute			
Frequency	26/yr	26/yr	NA
# Species	1	1	NA
Test type	Single concentration	Single concentration	NA
Unit cost	$387 (*Oncorhynchus mykiss*)	$387 (*Oncorhynchus mykiss*)	NA
Annual cost	$10,100	$10,100	$0
Chronic			
Frequency	4/yr	12/yr	NA
# Species	1	1	NA
Test type	Multiple dilutions	Single concentration	NA
Unit costs	$1,502 (*Haliotis rufescens*)	$845 (*Haliotis rufescens*[1])	NA
Annual cost	$6,000	$10,100	$4,100
Total			
Annual cost	$16,100	$20,200	$4,100

NA = not applicable.
1. Based on *Haliotis rufescens* as most sensitive species under the Amendment because the permit indicates that it is the most sensitive species under the baseline.

Total incremental costs associated with routine monitoring for the discharger may be $4,100 per year.

Also, incremental cost savings associated with initial RP monitoring (chronic three species testing) would likely be minimal because the permit already requires at least three multiple

dilution tests per species for permit renewal (the Amendment requires four single concentration tests per species).

Thus, total incremental costs may range from approximately $2,700 to a cost of approximately $18,000 per year.

Potential Total Annual Incremental Compliance Costs: USS-POSCO Industries

Routine Monitoring	3-Species Sensitivity Monitoring	Permit Limit Compliance	Total Annual
$4,100	$0	-$1,400 to $13,900	$2,700 to $18,000

A.14 Victor Valley Regional WWTP

The following sections document the incremental compliance analysis for the sample facility.

A.14.1 Facility Information

The following exhibit summarizes general information about the facility.

General Information: Victor Valley Regional WWTP

Name	Victor Valley Regional WWTP
NPDES No.	CA0102822
Category	Major municipal
Flow (mgd)	14
Receiving water	Mojave River
Existing treatment level	Tertiary
Existing treatment train	The treatment system consists of headworks, primary clarifiers, flow equalization, aeration basins, secondary clarifiers, coagulation/flocculation, filtration, and chlorination/dechlorination, and sludge handling.

A.14.2 Existing Permit Requirements

The following exhibit summarizes the existing permit requirements related to WET testing for the sample facility.

WET Permit Requirements: Victor Valley Regional WWTP

Permit issue date	2/14/2008
Permit expiration date	4/4/2013
Dilution	None
Acute monitoring	Quarterly; 1 species (*Pimephales promelas*)
Acute limits	< 90% survival of *Pimephales promelas* in undiluted effluent in 50% of the samples in a calendar year; or < 70% survival of *Pimephales promelas* in undiluted effluent in 10% of the samples in a calendar year.
Chronic monitoring	Annually; 2 species (*Ceriodaphnia dubia, Pimephales promelas*); 100% effluent
Chronic limits	None
Accelerated monitoring trigger	Acute: survival of < 90% in 2 consecutive quarterly samples, increase frequency to once per month. Chronic: statistically significant difference between sample of 100% effluent and a control, increase frequency to once per month.
TRE trigger	If acute or chronic toxicity is detected during accelerated testing, the Discharger shall initiate a TRE within 15 days of receipt of the final acute or chronic toxicity test results in order to reduce the causes of toxicity.
Resume regular testing condition	Acute: When 3 consecutive monthly tests demonstrate a survival rate of >90%, the Discharger may resume acute WET testing at a frequency of once per calendar quarter. Chronic: When 3 consecutive accelerated monthly tests demonstrate no chronic toxicity, which is defined as WET test results not exceeding 1.0 TUc, the Discharger may resume regular chronic WET testing at a frequency of once per calendar year.

A.14.3 Baseline Compliance

The following tables summarize WET data from 1/30/07 – 4/10/08 under the existing permit.

Baseline Compliance, Acute Toxicity: Victor Valley Regional WWTP

Species	*Pimephales promelas*
Test	Survival
# of tests	6
# exceeding limit	0
# exceeding accelerated monitoring trigger	0
Exceeding TRE trigger? (Y/N)	N

Baseline Compliance, Chronic Toxicity: Victor Valley Regional WWTP

Ceriodaphnia dubia	
Test	Survival and reproduction
# of tests	2
# exceeding accelerated monitoring trigger	0
Exceeding TRE trigger? (Y/N)	N
Pimephales promelas	
Test	Survival and growth
# of tests	3
# exceeding accelerated monitoring trigger	0
Exceeding TRE trigger? (Y/N)	N

The discharger is in compliance with WET requirements in the current permit.

A.14.4 Amendment Compliance

The discharger has RP under the Amendment because it is a major WWTP. The following table summarizes WET data from 1/30/07 – 4/10/08 under the Amendment.

Effluent Data Analysis under the Amendment, Chronic Toxicity: Victor Valley Regional WWTP

Ceriodaphnia dubia	
Test	Survival and reproduction
# of tests	2
# of potential exceedances of MDEL	0
Pimephales promelas	
Test	Survival and growth
# of tests	3
# of potential exceedances of MDEL[1]	0
# of potential exceedances of MMEL	2*
1. Based on survival results only. *Uncertain because there were no additional tests in the same calendar month to determine compliance	

Under the Amendment, the discharger will have to conduct three-species screening to determine the most sensitive species for chronic monitoring. Existing data are only available for *Ceriodaphnia dubia* and *Pimephales promelas*.

Two "fail" results with percent effects below 50% for *Pimephales promelas* would trigger monitoring to assess compliance with the MMEL. Because the data to assess compliance with the MMEL are not available, Abt Associates estimated potential compliance based on both potential outcomes: 1) monitoring indicates exceedance of the MMEL and 2) monitoring indicates compliance with the MMEL.

A.14.5 Potential Incremental Impact Summary

Under the scenario in which confirmatory monitoring indicates that the facility is exceeding the MMEL, the facility would likely incur incremental costs under the Amendment for additional monitoring associated with determining compliance with the MMEL and to conduct accelerated monitoring and a TRE. Thus, incremental costs would be approximately $15,200 per year.

Under the scenario in which additional monitoring indicates that the facility is in compliance with the MMEL, there would only be incremental costs associated with additional monitoring to determine compliance with the MMEL of approximately $400 per year.

Potential Incremental Permit Limit Compliance Costs: Victor Valley Regional WWTP

Scenario	Exceed MDEL	Verification Test Costs	Total Incremental Costs			Incremental Annual Costs[2]
			MMEL Monitoring[1]	Accelerated Monitoring	TRE	
Comply with MMEL	No	$0	$1,200	$0	$0	$400
Exceed MMEL	No	$0	$1,200	$4,500	$40,000	$15,200

1. Represents unit cost of $607 per test (average of 3 freshwater species tests) for follow-up tests for 2 exceedances of MMEL monitoring triggers.
2. Total incremental costs divided by the period of the data evaluated (3 years).

In addition, routine monitoring requirements would change under the Amendment in that Abt Associates assumed that permit writers would not require acute monitoring under the Amendment, as shown in the table below. Chronic monitoring will be monthly, but with one species (most sensitive) and single-concentration tests.

Routine Monitoring: Victor Valley Regional WWTP

Component	Baseline	Amendment	Incremental
Acute			
Frequency	4/yr	NA	NA
# Species	1	NA	NA
Test type	Single concentration	NA	NA
Unit cost	$352 (*Pimephales promelas*)	NA	NA
Annual cost	$1,400	NA	-$1,400
Chronic			
Frequency	1/yr	12/yr	NA
# Species	2	1	NA
Test type	Single concentration	Single concentration	NA
Unit costs	$674 (*Ceriodaphnia dubia*) $600 (*Pimephales promelas*)	$607 (Uncertain[1])	NA
Annual cost	$1,300	$7,300	$6,000
Total			
Annual cost	$2,700	$7,300	$4,600

NA = not applicable.
1. Sensitive species is uncertain; cost represents average of all freshwater species.
Note detail may not add to totals due to independent rounding.

Incremental costs associated with routine monitoring would be $4,600 per year.

There will also be a cost of initial RP monitoring of approximately $6,200 at the beginning of each permit cycle (based on four samples per species and average single-concentration chronic test costs for freshwater vertebrates, invertebrates, and aquatic plants), or $1,200 per year (assuming a five-year permit cycle).

Thus, total incremental costs for compliance with the Amendment may range from $6,200 to $21,000 per year.

Potential Total Annual Incremental Compliance Costs: Victor Valley Regional WWTP

Routine Monitoring	3-Species Sensitivity Monitoring	Permit Limit Compliance	Total Annual
$4,600	$1,200	$400 to $15,200	$6,200 to $21,000